United States
Department of
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Animal and
Plant Health
Inspection
Service

National Boll Weevil Cooperative Control Program

Final Environmental Impact Statement—1991

Volume 2

National Boll Weevil Cooperative Control Program

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Volume II

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Appendix D

Public Comments and Responses

This appendix contains all the comments received on the National Boll Weevil Cooperative Control Program draft environmental impact statement (EIS) and the supplement, and APHIS' response to these comments. Each of the 34 comment letters received is in this appendix, in its entirety, or comment by comment. APHIS has responded to all substantive comments, either in this appendix or in the text of the EIS. If APHIS' response is contained in the text of the EIS, the reader is directed to the section that was changed in response to the comment.

Comment Letter Number 1

From:

Mason S. Carbaugh
Department of Agriculture and Consumer Services
Commonwealth of Virginia
P.O. Box 1163
Richmond, VA 23209

Comment 1A:

This is in reply to the request for comments on the Draft National Boll Weevil Cooperative Control Program.

The Department concurs with the recommendation of Alternative 2: Beltwide Eradication Program—Full Federal Involvement, as in the preferred alternative. We commend USDA/APHIS for its efforts in the preparation of the Draft Environmental Impact Statement (DEIS). The DEIS is especially detailed and adequately describes the alternatives as well as the impacts for each.

It should be noted that this is not a new program, but a continuation of the successful trial eradication program which began in 1978 in Virginia and northern North Carolina. Since eradication of the boll weevil in these two states, benefits have accrued both to the grower and the environment. In the original eradication area of Virginia and North Carolina, insecticide treatments have averaged two per season on cotton for the past ten years compared to over ten treatments per season prior to the eradication program. This has resulted in significant savings to the growers, a major increase in cotton production, and a reduction in the use of pesticides.

As in the past, for the continued success of the program, there must be full federal involvement. Federal participation provides the necessary coordination between the states and provides technical expertise as well as financial support to the program.

Response: Thank you for your comment.

Comment Letter Number 2

From:

D. D. Hardee
Southern Field Crop Insect Management Laboratory,
USDA, ARS
P.O. Box 346
Stoneville, MS 38776

Comment 2A:

I do not think the Figure 1-2 (p. 1-4) on infested areas of boll weevils is accurate. A large portion of northwest Texas (south and east of Lubbock) is infested, some of it heavily. Dr. Ron Rummel of Texas A&M Experiment Station at Lubbock, TX, can provide you with a more accurate picture.

Response: The necessary corrections have been made to Figure 1-2 in response to your comment. The High Plains are considered to be weevil-free. Occasionally, however, a few fields along the perimeter of Caprock become infested. These infestations have not carried into the next season because of control activities, harsh winters, and poor overwintering habitat. The area south of the High Plains is infested, as indicated in the EIS.

Comment 2B:

I do not think the Figure 1-2 (p. 1-4) on infested areas of boll weevils is accurate. Should you show NC and SC as "uninfested"—What about the repeated trap captures in both states every year?

Response: The map indicates that the weevil is not infesting the area above Interstate 26 in South Carolina or the entire State of North Carolina. This is accurate. The few remaining infestations are being eliminated this season (1991) in the old buffer zone in South Carolina. This area includes cotton grown between Interstate 26 and the Savannah River (Georgia State line).

Occasionally, single weevils are detected in traps in eradicated areas. These detections are usually later in the season when migratory pressure is greatest in the infested areas to the south. Of the few weevils detected, most are found along major north-south transportation routes. If multiple weevils are detected, the field is treated and the reintroduction eliminated.

Comment 2C:

I believe "azinphosmethyl" is one word, not hyphenated.

Response: According to the 1983 Merck Index, azinphos-methyl is hyphenated. However, the unhyphenated version is a valid alternative spelling.

Comment 2D: In Table 4-5 on resistance, did you mean to ignore widespread resistance of *Heliothis virescens* to pyrethroids and cotton aphids to several OP's?

Response: Table 4-5 has been revised in response to your comment.

Comment 2E: I am listed twice in the Distribution List on page 7-10. My correct address is USDA, ARS, P.O. Box 346, Stoneville, MS 38776.

Response: The distribution list has been revised in response to your comment.

Comment Letter Number 3

From:

Randall C. Wilson
North Carolina Wildlife Resources Commission
512 N. Salisbury Street
Raleigh, NC 27611

Comment 3A: We have reviewed the DEIS-1989 for the National Boll Weevil Cooperative Control Program and wish to submit the following comment.

We recommend that if there occurs a need to expand the eradication program back into North Carolina, that the Commission be contacted in reference to state-listed endangered species.

Response: As stated under "Endangered and Threatened Species and Critical Habitat Requirements" in chapter 5, site-specific environmental assessments will involve cooperation with State wildlife specialists to evaluate the impacts on State-protected species. Appropriate protection measures for these species will be identified in the site-specific environmental assessments.

Comment Letter Number 4

From:

Isi A. Siddiqui
Department of Food and Agriculture,
State of California
1220 N Street
Sacramento, CA

Comment 4A:

The California Department of Food and Agriculture (CDFA) has completed its review of the Draft Environmental Impact Statement (DEIS) for the National Boll Weevil Cooperative Control Program. We support the preferred alternative, Beltwide Eradication Program with full Federal involvement. The selected alternative uses an integrated control approach and affords the greatest opportunity for eradication of this serious pest.

Cotton production in California annually exceeds 1 million acres. Cotton is among the state's top farm products and ranks as one of our leading farm exports. California has been a participant in the Southwest Boll Weevil Eradication Program since 1984. This cooperative control program has been extremely successful in reducing boll weevil populations. The integrated control techniques are achieving program goals, while minimizing adverse effects on the environment. Cotton boll weevil catches have not occurred within the cotton-producing areas in California during the 1989 season.

We found the DEIS to be a well written and comprehensive document. The California Department of Food and Agriculture appreciates the opportunity to review the 1989 DEIS for the National Boll Weevil Cooperative Control Program.

Response: Thank you for your comment.

Comment Letter Number 5

From:

Steven A. Lewis
Oklahoma Department of Wildlife Conservation
1801 N. Lincoln
Oklahoma City, OK 73105

Comment 5A:

The control methods identified in the Draft EIS include several nonchemical alternatives, such as cultural control, mechanical control and sterile insect technique. We support the use of nonchemical

methods and believe that a pest control strategy should be structured to accomplish its goals with an absolute minimum release of toxic substances into the environment. To this end, greater emphasis must be given to the selection of nonchemical control measures and to their incorporation into a control strategy. Therefore, we recommend that the DEIS be revised to reflect a stronger endorsement of nonchemical control methods.

Response: Several nonchemical alternatives for controlling the boll weevil are described in chapter 2 of the EIS. The limitations associated with each of these alternatives are also explained. The preferred goal of the program is the beltwide elimination of the boll weevil to the point where individuals are no longer detectable. For the reasons given in chapter 2, the various nonchemical alternatives currently available have limited application in eradication efforts of significant size. As nonchemical methods of control become more effective and acceptable to cotton producers, those methods will be considered for use in the program.

Comment 5B:

The DEIS discusses in some detail the toxic nature of the pesticides proposed for use as chemical controls for boll weevils. Also discussed is the impact these chemicals have on fish, wildlife, humans, and other nontarget organisms. Because of the toxic nature of these chemicals, recommendations for mitigation measures are outlined in Table 2-1 on page 2-9. These measures address the protection of workers, the public and bees. Mitigation measures for fish and wildlife resources are noticeably absent from this table and from the DEIS in general. The only reference to mitigation measures for fish and wildlife resources is for federally listed threatened and endangered species in Table 2-2 on page 2-10 through 2-13. We believe it entirely appropriate and necessary that mitigation measures be developed for fish and wildlife resources and recommend that the DEIS be revised to include them.

Response: Whenever necessary, site-specific environmental assessments will involve agencies responsible for the conservation of fish and wildlife resources.

Comment 5C:

Environmental monitoring for the boll weevil control program is listed as an operational procedure in Table 2-2. This monitoring is to be in accordance with current environmental monitoring plans, although these plans are not well-referenced. Environmental monitoring is also discussed in the first paragraphs of page 5-8 and 1-15; however, the DEIS does not present any detailed information about minimum monitoring plan design or requirements. Environmental monitoring is, for this Department, an extremely important component of the proposed control program. Although the specific implementation of this monitoring will probably vary regionally, the DEIS should still identify and discuss in detail the monitoring alluded to on page 1-15, as well as the current environmental monitoring plans referred to in Table 2-2.

Response: In response to your comment, the discussion in chapter 1 has been expanded to include more details of APHIS monitoring activities.

Comment 5D:

Most importantly, the DEIS should identify the minimum basic components that will be required of an environmental monitoring plan and outline a sampling strategy that will address fish and wildlife, their habitats and the various media (air, water, etc.) that will be affected. This will help ensure consistency in monitoring plan design, sample collection, data analysis, and comparability of results throughout the program area. We also recommend that the plan include provisions for chronic and acute toxicity and bioaccumulation testing for representative species of fish and wildlife.

If irrigated lands are involved, tailwaters should be included in the sampling regime, particularly where irrigation tailwaters are released to waters of the State.

Response: Individual environmental monitoring plans will be developed as the program moves into new increments if it is determined that the current plan is not sufficient to address concerns in the new increment. Details such as those mentioned in this comment will be handled in these site-specific monitoring plans. Additional information on existing monitoring plans has been added to chapter 1.

Comment Letter Number 6

From:

T. B. Davich
Boll Weevil Research Unit, USDA-ARS
P.O. Box 5367
Mississippi State University, MS 39762

Comment 6A:

Page S-6: A brief statement in alternatives and control methods eliminated from detailed study. This includes resistant plant varieties. Chapter 2, pages 21 and 22 goes into more detail. I should like to see S-6 modified to indicate that much research is being done to develop resistant varieties. When such agronomically and entomologically acceptable varieties are developed they should be incorporated into the boll weevil cooperative program. In view of the many years to conduct the program, I am sure that sometime "down the pike" we will have them.

Response: APHIS believes that the level of detail on this subject provided on page S-6 is sufficient for the executive summary of the EIS. Please note that the paragraph directs the interested reader to chapter 2 if further information is desired.

Comment 6B: Page S-7, 5th paragraph: ...only infested areas would receive applications. Need to spell out what kind of applications.

Response: This statement has been clarified in response to your comment.

Comment 6C: Page 1-1, last paragraph: ...(Knipling 1983) because the boll weevil can cover a distance of 65 miles with movement largely dependent on wind direction and speed.... Guerra, and I think others, have shown 85 or more miles is more like it.

Response: The information in the article mentioned has been added to chapter 1 in response to your comment.

Comment 6D: Page 2-1: Should not quarantine measures be included in the introduction?

Response: Regulatory authority during the boll weevil eradication program rests with the cooperating States. Each State involved in the eradication effort has established its own authority to restrict the movement of high risk regulated items into and through its jurisdiction.

Although California is the only State with an actual quarantine against the boll weevil, the other cooperating States do have a mechanism for effectively controlling the artificial movement of the pest. We would not consider these regulations and their enforcement to be a "control strategy."

Comment 6E: Page 2-1, last paragraph: Should not hazards to the environment be stated because of the continual need for the use of pesticides?

Response: The commenter is correct; the potential environmental risk from annual, non-program control efforts would continue into the indefinite future. This fact is mentioned several times in the document.

Comment 6F: Page 2-2: alternatives and control measures eliminated from detailed study. See comments on S-6.

Response: Detail on this subject is provided in the section titled "Alternatives Eliminated from Detailed Study." The referenced text is an introductory section.

Comment 6G: Page 2-6, last paragraph, 1st sentence: boll weevils are reared in an antiseptic environment not aseptic.

Response: This sentence has been revised in response to your comment.

Comment 6H: With modifications to the Robert T. Gast rearing facility, Jon Roberson informs me that he could rear 30 million weevils per week. Details on these modifications will follow later, if you so desire.

Response: As noted on page 2-7 of the EIS, there are at least four factors that currently prevent the use of sterile boll weevils in an eradication program:

- Determining the most effective ratio of sterile to wild weevils;
- The inability to adequately measure the size of a native weevil population;
- The inconclusive nature of eradication field tests involving sterile weevils; and
- The limited production capacity of the Gast rearing facility.

The conclusion is the same—it will take more research and more money before the sterile boll weevil is considered for use on significant acreage in an eradication program.

Comment 6I: Page 2-17, Table 2-3: Should you not remove the footnote referring to the minute amounts of propoxur and chlorpyrifos that may be enclosed in the pheromone strips and state under application method "Laminated insecticide strip in pheromone traps"?

Response: There is a significant distinction between materials that are broadly applied by aircraft, and the minute amount enclosed as killing agent in program traps. This distinction has been made more clearly in table 2-3.

Comment 6J: Page 2-29, Figure 2-1: Why are the increments called control programs? Why not eradication programs?

Response: Alternatives are being analyzed; the eradication program is one of the alternatives. Present and past program increments have been called eradication programs, and they are so represented in figure 2-1. For the purposes of this EIS, the program's title uses the word control for all future increments.

Comment 6K: Page 2-30, last paragraph, last sentence: "In a small % of heavily infested fields as many as 25 treatments..." What is a small %?

Response: In about 1 field in 1,000 as many as 25 treatments may be required during the first full year of the program. This change has been made in chapter 2.

Comment 6L: Page 3-3, Geology paragraph: "Landforms such as mountains can also serve as significant barriers to boll weevil dispersal." What is the basis for this statement?

Response: This statement has been revised in response to your comment.

Comment 6M: Don Rummel caged some weevils on the Cap Rock and found that they could survive the winter. I asked one of his associates to send you the information.

Response: This section has been revised to incorporate the information received from Don Rummel in his comments on the DEIS.

Comment 6N: Page 4-37, last sentence: ...greatest detrimental impact...

Response: This statement has been revised in response to your comment.

Comment 6O: Page 4-71: Table 4-8 is not clear to me.

Response: The table has been clarified in response to your comment.

Comment 6P: Page 4-72, 3rd paragraph: Is the Gast Lab (MSU campus) considered to be Stoneville or should it not be stated MSU campus?

Response: This sentence has been revised in response to your comment.

Comment Letter Number 7

From:

Frank A. DuBois
New Mexico Department of Agriculture
Box 30005, Dept. 3189
Las Cruces, NM 88003-0005

Comment 7A: Our concern is consistent funding over the next two decades. The table on page 4-75 shows that eradication in southern Texas is projected to begin in the year 2009. Such long-term planning is a positive sign, particularly when dealing with such a complex biological problem. However, nowhere in the document does APHIS discuss contingency plans if federal and/or state funds are not available. What would be done to protect those areas where the boll weevil had been successfully eradicated? Would APHIS establish trapping and/or cotton free barrier areas to prevent re-introduction?

Response: There will always be a degree of uncertainty regarding the availability of Federal funds. Such uncertainty should not prevent interested parties from pursuing worthwhile objectives. There is no way to predict what our specific response will be 20 years from now if sufficient funds were not available.

In a general sense, however, there are some obvious steps that would be taken if sufficient funds were not available. These could include: preventing weevil reintroduction by enforcing State regulations regarding the movement of high-risk regulated articles and preventing weevil reintroduction by establishing the most effective buffer possible. Within that buffer we would use extensive trapping to determine weevil population levels, and would apply the most effective control technologies available. This concept has been used successfully for 25 years on the Texas High Plains and in each increment of the current eradication programs.

There is an obvious benefit in reducing the amount of cotton grown in a buffer zone. The economic hardship associated with eliminating cotton from a specific area of the Cotton Belt, however, makes such an occurrence unlikely.

Cotton growers in Virginia and the Carolinas strongly endorse ongoing acreage assessments to fund post-eradication activities. These activates include seasonal trapping surveys and rapid response to any isolated reintroductions.

In California and Arizona the funding mechanism is different, but the support for ongoing maintenance activities is just as strong.

Comment Letter Number 8

From:

Don R. Rummel
Texas Agricultural Experiment Station
Texas A&M University
Rt. 3
Lubbock, TX 79401

Comment 8A:

In chapter 3, page 6 under the heading of South Central Program Area, the following statement appears, "Although it is generally thought that the boll weevil cannot survive the High Plains winters, occasional infestations along the Cap Rock in the High Plains have increased to destructive levels and have required treatment." I want to point out that only part of this statement is true. It is true that infestations along the edge of the Cap Rock in the High Plains do sometimes reach destructive levels. However, it is not true that the boll weevil cannot overwinter on the High Plains.

Studies conducted during 1963-64 showed that small numbers of weevil did survive the winter in sorghum alum grass on the Texas High Plains (Adkisson et al. 1965). Bottrell and Rummel (1972) reported that boll weevils survived the 1969-70 winter in central Andrews county which is located in the southwestern portion of the High Plains. More recent

studies have confirmed that the boll weevil is capable of surviving winters in the Texas High Plains if suitable overwintering habitat is available. During the past two winters we have confirmed boll weevil overwintering in Conservation Reserved Program grasses on the High Plains (S.C. Carrol and D.R. Rummel, unpublished report to Plains Cotton Growers Inc.).

There are adequate data showing that the boll weevil can, and at times has successfully overwintered on the Texas High Plains. There is little question that had the High Plains boll weevil suppression program not been initiated, weevils would be established in many local areas of the High Plains where suitable overwintering habitat exists.

As a result of the Conservation Reserve Program, thousands of acres of grasses are being established on the Texas High Plains. Our studies to date indicate that small numbers of weevils do survive the winter in these grass plantings along the eastern edge of the High Plains. Because much of the cotton in the High Plains is irrigated, the reproductive potential of the boll weevil population would not be restricted as it is in the predominantly dryland Rolling Plains area. Thus, even limited numbers of overwintered boll weevils could develop into damaging infestations. While natural overwintering habitat for the boll weevil is limited in the Texas High Plains, it does exist in some areas. The Conservation Reserve Program has now greatly increased the amount of boll weevil winter habitat in the area. While the CRP grasses do not offer the most favorable type habitat we feel that they do increase the potential hazard.

Response: This section has been revised in response to your information.

Comment Letter Number 9

From:

Harold J. Hartley
Commodity and Marketing Division
American Farm Bureau Federation
225 Touhy Avenue
Park Ridge, IL 60068

Comment 9A: The American Farm Bureau Federation is pleased to offer its comments on the Draft Environmental Impact Statement (DEIS) on the National Boll Weevil Cooperative Control Program. Farm Bureau and the cotton producers it represents strongly support the full federal eradication program, which is the preferred alternative of the DEIS....

Response: Thank you for your comment.

Comment Letter Number 10

From:

Gedi Cibas, Ph.D.
Environmental Improvement Division
New Mexico Health and Environment Department
Harold Runnels Building
1190 St. Francis Dr.
Santa Fe, NM 87503

Comment 10A:

The "integrated" approach to eradication of this pest in fact depends almost exclusively on pesticide applications.

Response: The proposed approach to eradication does integrate a variety of activities.

Pheromone traps are used to detect and delimit the weevil population in each field. If weevils are not detected in a field, that field is not treated. (No fields will be treated "just in case.")

Treatments are only applied when the number of weevils in a given field has exceeded an established threshold for that week.

Growers are encouraged to grow short-season varieties of cotton to increase the host-free period and to reduce the reproductive potential of the weevil each season.

Growers are also encouraged to pick their cotton as early as possible and to destroy their stalks immediately. This reduces the number of treatments required in the fall and also reduces the number of overwintered weevils the following spring.

Various nonchemical control methods are described in chapter 2. As mention above, the program encourages the use of several cultural control practices. For reasons explained in chapter 2, mechanical control and the sterile weevil have limited application in eradication efforts of significant size. Considering the preferred goals of the program, chemical controls are the most effective short-term investment for realizing the long-term benefits of weevil eradication. We acknowledge that chemical control, applied over a relatively short period of time, will play a critical role in eliminating the pest.

Comment 10B:

The four pesticides to be used are, at least, "moderately" toxic to nontarget species of all types including beneficial insects, waterfowl, fish, and humans.

Response: This is acknowledged in the analysis in chapter 4. Thank you for your comment.

Comment 10C: It should also be noted that such an eradication process is doomed to failure; pesticide applications result in selection of "super-bugs." Genetic differences occur in all populations and this program would result in those "resistant" organisms becoming dominant in the environment.

Response: No data have been found to indicate that the proposed program methods will result in resistant boll weevils ("super-bugs"). The proposed program involves control activities over a 3-year period within each increment. During those 3 years, the program treatments are similar to what would otherwise be applied by the individual growers to control the boll weevil. After those 3 years of program activity, individual growers no longer have to apply boll weevil pesticides. And that benefit accrues each year thereafter for as long as cotton is grown.

Comment 10D: Cotton is grown throughout northern Mexico which would insure reintroduction of the boll weevil almost immediately.

Response: Cotton grown in northern Mexico is in five specific locations: Mexicali, Caborca, Juarez, Presidio, and the lower Rio Grande Valley.

The areas in Mexicali and Juarez are weevil-free. Near Presidio, very small fields total less than 100 acres. These are being monitored with traps to detect and prevent any weevil movement into the United States. In Caborca, growers have requested assistance from the United States in eradicating the boll weevil. This season they have voluntarily trapped their cotton and applied the necessary treatments. The Mexican cotton in the lower Rio Grande Valley could be included in program activities in the adjacent area of Texas. Such a cooperative effort was successful in Mexicali. The threat of weevil migration toward the United States from the interior parts of Mexico is insignificant.

Comment 10E: Staff strongly recommend that intense biological control techniques be utilized to control this pest in place of pesticide applications. The pesticides recommended pose too great a threat to other elements of the ecosystem.

Response: As stated under "Alternatives Eliminated from Detailed Study" in chapter 2, boll weevil control throughout the United States without some use of chemical insecticides is not presently considered economically and technically feasible. Please refer to this section for a detailed discussion of this issue.

Comment 10F: After a cursory review of the EIS, I concur with Jim Piatt on suggestions on no use of pesticides to control the weevil. Biological control of the weevil would be the option preferred over large scale chemical control methods.

Response: As stated under "Alternatives Eliminated from Detailed Study" in chapter 2, boll weevil control throughout the United States without some use of chemical insecticides is not presently considered technically and economically feasible. Please refer to this section for a detailed discussion of this issue.

Comment 10G:

I believe the EIS should address the various chemicals from the standpoint of longevity in the environment and not the LD_{50} toxicity to impacted animals. Buildup in soils of chemicals over time can also lead to introduction of chemicals into the food chain and build up chemical levels in animals to toxic quantities.

Response: The persistence of the insecticides in soil is addressed in chapter 4. As stated in that section, none of the four insecticides is persistent in soil. Their soil half-lives are: 3 days for malathion, 12 days for azinphos-methyl, up to 1 week for diflubenzuron, and 5 days for methyl parathion. The potential for accumulation of program chemicals in the food chain is presented in chapter 4 also. The bioconcentration factors for the program chemicals are as follows: malathion, 37; azinphos-methyl, 40; diflubenzuron, 100; and methyl parathion, 87.

Organophosphates do not bioaccumulate; that is, once an organism is no longer exposed to the chemical, the presence of that chemical in its tissues dissipates.

Comment Letter Number 11

From:

F. G. de Boer
Crop Protection Division, Duphar B.V.
Boekesteyn, Noordereinde 56
1243 Jj's-Graveland Holland 035-68211

Comment 11A:

We wish first to state that the risk analysis procedure used in the draft Environmental Impact Statement - 1989 is done on the basis of a NOEL and compares actual and worst case occupational and bystander exposures to that NOEL. The procedure is understood. However, it disregards the fact that, first, regarding acute effects, the EPA/Toxicology Branch has classed Dimilin® 25W as a Toxicity Category IV product. This determination takes into account occupational, bystander, and possible accidental exposures. Listing human hazards or personal protective clothing on the label are not required.

Response: The EPA Toxicity Category refers only to acute toxicity. Because this risk assessment also evaluates chronic risks from repeated

exposures, which may occur at much lower levels of exposure, the acute toxicity category is not used to evaluate long-term risks.

Comment 11B:

Regarding chronic effects in recent studies submitted to the EPA, diflubenzuron was classified as not an oncogen (EPA Pesticide Fact Sheet No. 68.1 March 11, 1987) in both the rat and the mouse at feeding levels up to 10,000 ppm. However, the draft EIS still calculates a cancer potency factor based on a mouse oncogenicity study conducted in 1977. That study is obsolete and overruled by a new study at dose levels up to 60 times higher than in the old mouse study.

Response: Although the weight of evidence would appear to indicate that diflubenzuron is not oncogenic, the conservative nature of this risk assessment is in accord with a cancer risk evaluation for diflubenzuron based on the 1977 study. At present, EPA has classified diflubenzuron into Category D, meaning that there is inadequate evidence to classify it as to human carcinogenicity. However, the discussions in chapter 4 and appendix B of the EIS have been revised to reflect the uncertainty inherent in this issue.

Comment 11C:

No adverse reproductive or developmental effects have been found in studies conducted in the rat, mouse or rabbit. Despite these facts, this report makes frequent references, and calculates risk, based on the potential for diflubenzuron to produce adverse reproductive effects in man. These inferences are incorrect and misleading.

Response: The discussions in chapter 4 and appendix B have been revised to reflect that no reproductive or developmental effects have been observed at the highest doses tested in laboratory animal studies with diflubenzuron.

Comment 11D:

Page 2-19, last Dimilin paragraph: the carcinogenicity statement is incorrect and should read: "there is conclusive evidence that diflubenzuron is not an animal carcinogen"; see also our comments on Page B2-12.

Response: EPA has classified diflubenzuron into Category D, meaning that there is insufficient evidence to classify it as to its carcinogenic potential.

Comment 11E:

Page 2-19: The statement "...but is extremely toxic to aquatic invertebrates..." is too much of a generalization. The correct phrasing would be "...but can be extremely toxic to certain aquatic invertebrates when going through moulting..."

Response: The statement "but is extremely toxic..." is taken directly from the EPA Pesticide Fact Sheet referenced earlier in your comment letter.

Comment 11F:

Page 2-40, Chemical control/Vegetation (Table 2-8): The paragraph on chemical control versus vegetation apparently stands for all chemicals.

That is incorrect. The last sentence reading "...Temporary impacts on pollinator dependent vegetation..." needs the additional statement "...depending on chemical used," because diflubenzuron is relatively harmless to pollinators in general and particularly for bees.

Response: This statement has been revised in response to your comment.

Comment 11G: Page 2-41, Chemical control/Human-public and Human-worker (as far as statements are based on alleged risks of carcinogenicity): because diflubenzuron is not carcinogenic, the text requires re-editing (see also our comments on page B2-12). The statement on reproductive effects is incorrect too; see our comments on Page 4-62.

Response: Regarding reproductive effects, the text has been revised in response to your comment. The discussion of the potential risks of cancer has been revised to reflect the uncertainty inherent in this issue.

Comment 11H: Page 4-41, last paragraph: Diflubenzuron is also registered for control of cotton leaf perforator, fall army worm, and beet army worm. Since 1988.

Response: This information has been added in response to your comment.

Comment 11I: Page 4-51: Delete diflubenzuron from last column of Table 4-6; the chemical is not carcinogenic and therefore, no cancer potency can be specified.

Response: The cancer potency value comes from EPA's 1979 Diflubenzuron Decision Document and is based on the 80-week mouse-feeding study. A footnote has been added to the table to reflect the uncertainty in drawing conclusions about the carcinogenicity of diflubenzuron.

Comment 11J: Page 4-52, first paragraph: The human reference dose of 0.02 mg/kg/day is based on both a 1 year feeding study in dogs and a 2 year rat study.

Response: According to the EPA diflubenzuron tox one-liner (1988f) and the EPA reference dose tracking report, the dog study is the principal study on which the reference dose is based.

Comment 11K: Page 4-52, first paragraph: This paragraph reads: "Diflubenzuron has not demonstrated the ability to induce reproductive or developmental effects in lab animals." Yet, time and again, risks of reproductive effects are stated to be present. This is not so. See also our comments on Page 4-62.

Response: These statements have been clarified in response to your comment.

Comment 11L: Page 4-52, first paragraph: "Data from a mouse carcinogenicity study..., it was therefore considered a carcinogen in this analysis." See however our comments on page B2-12! Diflubenzuron is not a carcinogen.

Response: This statement has been clarified to reflect the uncertainty inherent in this issue.

Comment 11M: Page 4-57, 18th line from top of page: diflubenzuron must be deleted; it is not a carcinogen.

Response: This statement has been revised to reflect the uncertainty inherent in this issue.

Comment 11N: Page 4-58: Diflubenzuron is not a carcinogen! Therefore, in Table 4-7, the asterisks for the alleged carcinogenicity of diflubenzuron must be removed. Likewise, the "D" for dietary exposure and the "B" for applicator exposure should read "E."

Response: The cancer risk notation has been footnoted to reflect the uncertainty regarding diflubenzuron's carcinogenic potential. The "D" and the "B" refer to systemic risks only.

Comment 11O: Page 4-62, 4th paragraph: It is stated on page 4-52 that diflubenzuron "has not demonstrated the ability to induce reproductive effects..." On this page it is stated that there is "...slight to moderate risk of reproductive effects..." This is a contradiction.

Response: This statement has been clarified in response to your comment.

Comment 11P: We understood the procedure of taking the NOEL as the upper acceptable limit. However, a one generation reproduction study (EPA file MRID No. 0099724) using an exaggerated dose level of 5000 mg per kg body weight was not referenced in your report. This study showed that even at that level no effect was found on reproductive parameters. We therefore feel the warnings in the EIS about "slight", and/or "moderate" and/or "significant" risk of reproductive effects as the result of occupational or accidental exposure is unwarranted. Therefore, statements designed to mitigate an identified risk such as working in "...an enclosed cab or wearing protective clothing..." are unnecessary and we feel all references to possible reproductive effects should be deleted from the text.

Response: APHIS has contacted EPA about this study, but was unable to get this information before the final EIS was published. Discussions of reproductive risks of diflubenzuron have been qualified in the FEIS.

Comment 11Q: Page 4-62 and 63: Cancer risks are not existent because diflubenzuron is not a carcinogen! (see our comments on Page B2-12).

Response: The discussions of cancer risk from diflubenzuron have been qualified to reflect the uncertainty of diflubenzuron's carcinogenic potential.

Comment 11R: Page 4-89: Under beet army worm, include diflubenzuron. Under cotton leaf worm, include diflubenzuron.

Response: This information has been added in response to your comment.

Comment 11S: Page 4-90: Under fall army worm, insert diflubenzuron.

Response: This information has been added in response to your comment.

Comment 11T: Page B1-1: Diflubenzuron is not a carcinogen and need not be included in the risk estimate (14th line from page bottom).

Response: This statement has been qualified to reflect the uncertain status of diflubenzuron as to its carcinogenic potential.

Comment 11U: Page B2-4: LD_{50} for diflubenzuron stated to be larger than 4640 mg/kg b.w. This notation larger than must be read exactly as it stands. The LD_{50} for Dimilin® 25W is larger than 40,000 mg/kg b.w., which in terms of active ingredient is equivalent to an LD_{50} of 10,000 mg/kg b.w.

Response: As represented in the table, the value of >4,640 mg/kg places technical diflubenzuron into the category of lowest toxicity.

Comment 11V: Page B2-10: New teratogenicity studies have a NOEL of 1000 mg per kg b.w. As stated the reproduction NOEL is 8 mg/kg b.w. However, as stated before (page 4-62), in a one-generation reproduction study at 5000 mg/kg b.w., no effect on reproductive parameters was found.

Response: See the response to comment 11P.

Comment 11X: The first diflubenzuron paragraph, 3rd sentence, is misleading; see comment directly above. Diflubenzuron is not a carcinogen and the suggestive evidence in the invalid study is false!

Response: This statement has been clarified to reflect the uncertainty on this issue.

Comment 11Y: Page B2-21: The statement about "...the only conceivable human danger..." (under Human Toxicity) is sheer guesswork. In chronic toxicity [studies] up to levels of 10,000 ppm no evidence was found of effects on the nervous system. Also, in a 9 week study at 100,000 ppm, no such effects were found.

Response: This statement has been deleted in response to your comment.

Comment 11Z: Page B2-21: Acute LD_{50} Dimilin® 25 W is larger than 40,000 mg/kg bw and not 10,000 mg/kg.

Response: According to the EPA 1988 diflubenzuron tox one-liner, the acute oral LD_{50} for Dimilin® 25WP is >10,000 mg/kg; the MRID number for this study is 261486.

Comment 11AA: Page B2-21: The statement about the LD_{50} of 11,307 mg/kg on the mouse is from a source unknown to us and we strongly doubt the correctness of the data.

Response: This value is reported in the EPA 1988 tox one-liner for diflubenzuron; the MRID number for the study is 261486.

Comment 11BB: Page B2-22, starting at 8th line from page bottom: The statement about testosterone depression in chickens is based on false data from an invalid experiment. See our brochure "Fact Sheet on Dimilin®," the paragraph on effects on testosterone, page 4.

Response: The information to which this comment refers appears in the EIS as stated by EPA in the 1988 diflubenzuron tox one-liner. The study is not invalid, but is considered supplementary by EPA.

Comment 11CC: In conclusions to pages B2-21 and 22, it must be pointed out that recently EPA declared Dimilin® 25W to be a Toxicity Category IV product.

Response: Thank you for your comment. Table B2-1 presents diflubenzuron as being in Category IV.

Comment 11DD: Page B2-23: The Dimilin® carcinogenicity paragraph is misleading. As pointed out earlier in these comments, the mouse study at low dosage levels gave "suggestive evidence" of oncogenicity whereas a repeated study at 10,000 ppm (1,500 mg/kg/day) gave no evidence of oncogenicity. Therefore, there is no reason to assume "there is a possibility that diflubenzuron may present an oncogenic risk."

Response: This paragraph has been revised to reflect the inconclusive nature of the data on the carcinogenicity of diflubenzuron. Because of the suggestive evidence in the mouse study, the possibility of a carcinogenic effect cannot be eliminated.

Comment 11EE: Page B2-23: We believe the NIOSH reference on mutagenicity to be incorrect but have no possibility to check on that. The reference is not in our hands. We do know that mutagenicity has been extensively tested and that a false positive was reported.

Response: This study has been deleted from the mutagenicity discussion in the final EIS.

Comment 11FF:

Page B2-23: The immunotoxicity paragraph is misleading. Only Dimilin® 2F showed the response as described. Dimilin® 25W and diflubenzuron were completely negative in dermal sensitization studies. Dimilin® 25W is a Toxicity Category IV product!

Response: According to the 1988 EPA tox one-liner for diflubenzuron, the cited study was conducted with 90-percent active ingredient diflubenzuron.

Comment 11GG:

Page B3-17, the plant toxicity paragraph: This paragraph states "...diflubenzuron has been found to be taken up in several plants..." This statement is incorrect. It is a scientifically well established fact that diflubenzuron as such is neither absorbed nor translocated in the plant. Radioactivity found in plants is the result of root uptake of soil metabolites. Low residue levels found "in" cotton seed are the result of residue studies that do not differentiate between residues on the plant and in the plant. The residues in seed are the result of either direct spray contact or contamination at harvest and/or delinting. See also page B4-10, Fate on plants: "Spray residues do not enter the plant..."

Response: This paragraph has been revised in response to your comment.

Comment 11HH:

Page B5-7 through B5-32 and B6-4/5: For Dimilin®, dermal exposure is an invalid issue because it has been demonstrated in dermal treatment studies with radioactively labeled diflubenzuron that the compound is not absorbed.

Response: Studies in rabbits demonstrating methemoglobinemia in rabbits following dermal exposure (EPA 1988 tox one-liner for diflubenzuron) appear to contradict that assertion. The studies mentioned in the comment were not found in the available literature.

Comment 11II:

Page B5-26 and B5-29: As stated before, diflubenzuron is not a carcinogen and the suggestive evidence for oncogenicity is proven to be false.

Response: The possibility that diflubenzuron may be carcinogenic cannot be ruled out; the mouse study providing suggestive evidence is classified by EPA as supplementary. It has not been ruled invalid.

Comment 11JJ:

Page B7-1: In the definition of MOS we feel it is appropriate to state also that an MOS value of 1 represents a dose level in man that is equal to the NOEL found in animals.

Response: This information has been added in response to your comment.

Comment 11KK:

Page B7-4: Regarding "How cancer risks..." (10th line from top of page): Diflubenzuron is not a carcinogen. Suggestive evidence of carcinogenicity in an invalid study proven to be false!

Response: These statements have been qualified to reflect the inconclusive nature of the evidence as to the carcinogenicity of diflubenzuron.

Comment 11LL: Page B7-5, Risks from Control Operations: In the very last sentence of this paragraph diflubenzuron must be deleted because it is not a carcinogen!

Response: All discussions regarding cancer risks from diflubenzuron have been revised to reflect the inconclusive nature of the available information.

Comment 11MM: Page B7-21, Risks to Workers: The diflubenzuron paragraph is of course consistent with the procedures followed in the complete risk analysis. Yet it is appropriate to point out that if Dimilin® 25W is used, the LD_{50} of Dimilin® 25W should be used in calculations on safety margins and the LD_{50} for Dimilin® 25W is larger than 40,000 mg/kg body weight which is ten times higher than for diflubenzuron technical. Consequently, accidental exposures would be less than 0.1 to 0.15 percent of the NOEL in acute toxicity studies (because there was no mortality at all). Therefore, fatalities as a result of accidental spills of Dimilin® 25W or the spray liquid are not merely unlikely, they are extremely unlikely if not impossible at all.

Response: All estimations of doses and corresponding discussions of risks to workers and the public were adjusted for the amount of active ingredient present in the formulation. Also, in this risk assessment, doses in LD_{50} studies that do not lead to mortality are not considered NOELs if there was no mortality; a dose level is only considered a NOEL if there are no adverse effects of any kind observed.

Comment 11NN: Page B7-22 and 23: Delete diflubenzuron in the paragraphs on cancer risks to public and workers and worker accidents.

Response: These paragraphs have been revised to indicate the inconclusive nature of the available information on the carcinogenic potential of diflubenzuron.

Comment 11OO: Delete diflubenzuron from table B7-13.

Response: This information has been qualified to reflect the uncertainty in the available information on the carcinogenicity of diflubenzuron.

Comment 11PP: Page B7-25: Delete diflubenzuron from 3rd paragraph from top.

Response: The paragraph has been revised to reflect the uncertainty in the available information on the carcinogenicity of diflubenzuron.

Comment Letter Number 12

From:

Charles D. Travis
Texas Parks and Wildlife Department
4200 Smith Road
Austin, TX 78744

Comment 12A:

The Department recommends use of non-chemical treatments rather than chemical treatments. If chemicals are used, application methods to reduce or eliminate drift transport should be used (land application vs. aerial application). Possible contamination of surface waters should be avoided. Several of the suggested chemicals do not have sufficient information to accurately judge possible impacts. However, malathion, methyl parathion, and azinphos-methyl are toxic to fish and aquatic invertebrates and are projected to pose "significant risk" to the aquatic resources of the Red River. The Department has authority to seek damage restoration from parties responsible for pollution impacts on state natural resources and would seek such action if the chemical application in this project is conducted in a manner that is detrimental to state resources.

Response: Discussions of operating procedures and mitigation measures to address issues such as these have been added to the final EIS.

Comment 12B:

Table F-16 (p. F-94 and 95) lists only 18 plants as endangered and threatened by the State of Texas. There are now 21 listed plants (see enclosed copy of Executive Director Order Number 88-003). Not all of these protected plants are within the areas considered by this program.

Response: Appendix H has been revised to include these additional plant species.

Comment 12C:

Staff of the Texas Natural Heritage Program will work with concerned parties to review site specific effects of control actions and provide information on which species need to be considered. The major concern is whether pollinators of protected plant species will be affected by broad spectrum pesticides. Many of the protected plants have not had sufficient research conducted into their life histories to determine what the pollinator species are so this is a task the Department recommends if chemical treatments are chosen as the method of control within known habitat of protected plant species.

Response: APHIS looks forward to working with representatives of the State of Texas on these and other relevant issues before the program moves into Texas.

Comment Letter Number 13

From:

Deborah M. Wassenaar
Southern Environmental Law Center
201 West Main Street, Suite 14
Charlottesville, VA 22901-5033

Comment 13A:

The Stipulation of Settlement requires the USDA to analyze in the EIS a number of specific issues pertaining to the program in Alabama in addition to any other issues identified in the scoping process. As set forth below, very few of these items have been addressed.... The Draft EIS discusses current cotton grower practices in the cotton belt and in Alabama in only a cursory fashion and clearly does not include all of the information required by the Stipulation of Settlement.... The Stipulation of Settlement requires the USDA to include in the EIS a discussion of "the projected duration of the program in Alabama including an explanation of the intended scope of all phases of the program, including any maintenance phase. The document shall also set forth projections for expansion of the program into the remainder of Alabama, including timing of such proposed expansion...." The Draft EIS fails to analyze adequately the conditions specific to Alabama.... The Draft EIS fails to compare conditions in Alabama to areas where the USDA has deemed the program to be successful.

Response: In response to this issue, APHIS has prepared and published for public review and comment a Supplement to the DEIS containing a site-specific analysis of the program in Alabama. This supplement is now appendix I, the Implementation of the Program in Alabama, of the final EIS.

Comment 13B:

We are concerned about a number of gaps in the data that underlie the feasibility determination. We would note first that there is no information given about the areas where USDA is claiming eradication since 1981. For example, there is no information to indicate whether these previously "eradicated" areas remain free of weevils. USDA does state that it maintains a buffer zone to protect weevil migration into "previously eradicated" zones, but has admitted the presence of weevils in that area in its earlier draft environmental assessments for the Southeast Boll Weevil Eradication program. In addition, studies reveal that the trapping of boll weevils for detection levels is not 100% accurate, and in fact show an accuracy rate of closer to 60%. Given this level of uncertainty and because eight years have passed since the eradication trials took place, a thorough exploration of the current status of these areas is needed.

Response: Information on the current status of the regional boll weevil eradication programs has been added to the final EIS.

Comment 13C:

The draft EIS also fails to discuss cogently any of the scientific information that exists questioning the feasibility of eradication. The draft EIS briefly refers to the 1973 findings of a special committee in which the committee concluded that eradication had not been demonstrated and was not feasible for beltwide eradication. There is no further discussion of this conclusion, other than to say that follow up tests were performed.

Response: In response to comments on this issue, a discussion of the feasibility of the goal of eradication has been added to the final EIS. The follow-up testing cited in the comment letter demonstrated to the satisfaction of APHIS that boll weevil eradication is feasible. The program's success over extensive areas of previously infested cotton has confirmed the feasibility of eradication.

Comment 13D:

The draft EIS also omits mention or discussion of other studies, such as the 1981 review of the Virginia and North Carolina trial eradication program by a special committee of the National Research Council.... In its review, the Committee concluded that the design of the trial boll weevil eradication program was scientifically flawed, and that the program did not provide a basis for launching a beltwide eradication program, in part because it was impossible to draw statistically valid inferences from the trial program. Furthermore, the committee specifically recommended that a program of the nature of the one underway not be conducted.... More recently the USDA's own Economic Research Service admitted: "The high rate of return and the biological success of the eradication program from the Carolinas can be extended to other regions only with extreme caution." (Montgomery Advertiser, 22 October 1989).

Response: In response to comments on this issue, an evaluation of the feasibility of eradication has been added to the final EIS. APHIS feels that the benefits of weevil eradication far outweigh associated risks.

Comment 13E:

Finally, the document fails to consider the possibility and consequences of the failure of the program to achieve the goal of eradication. Since the USDA's proposed program is grounded in the goal of eradication, the failure to examine objectively this goal undermines the entire analysis.

Response: In response to comments on this issue, an evaluation of the feasibility of eradication has been included in appendix I, The Implementation of the Program in Alabama.

Comment 13F:

The draft EIS is woefully inadequate in failing to consider a full range of alternatives and in failing to evaluate objectively the alternatives presented. The draft EIS sets forth only three alternatives: 1) no action; 2) eradication; and, 3) suppression, with eradication as the preferred

alternative. The draft EIS fails to consider a full range of reasonable alternatives and specifically fails to address several alternatives required by the Stipulation of Settlement, namely: limited intervention with provision of guidance or instruction to growers concerning management practices; direct subsidies to cotton growers to control boll weevils with guidance as to control practices; and an integrated pest management approach.

The draft EIS explains the failure to include only one of the stipulated-to alternatives, the direct subsidy to growers. The USDA indicates that direct subsidy was eliminated as a reasonable alternative because it offers no long-term solution to the boll weevil problem, may not reduce the environmental impacts that may be associated with insecticide applications, and may not be reasonable under federal budgetary constraints. These rationales are insufficient to justify elimination of this alternative from full EIS scrutiny.... The USDA does not explain its failure to discuss two other alternatives it agreed to in the Stipulation, limited federal intervention and integrated pest management (IPM). Limited federal intervention could constitute a cost effective way to achieve the results of the program.... The lack of an IPM alternative represents a severe inadequacy. In the draft EIS, USDA several times characterizes the eradication alternative as an "integrated" control mechanism, but the agency concedes that the eradication alternative does not constitute an integrated pest management approach in part because the alternative seeks to eradicate rather than manage the pest population. Moreover, both eradication and suppression rely on the intensive use of pesticides as the primary means of control.... The draft EIS also fails to consider other alternatives that are consistent with the program purpose but that were not included in the Stipulation. One would be an alternative in which the use of higher risk pesticides is excluded.... The draft EIS should include an alternative in which pesticides such as azinphos-methyl and methyl parathion that pose higher risks to humans, wildlife, and the environment would not be used. Other alternatives that the agency should consider would be use of ground equipment in lieu of aerial application, and use of high volume spray methodology rather than ULV spraying, to reduce the potential for drift.

Response: The alternative consisting of direct subsidies to growers was eliminated from detailed consideration because that would not provide a long-term solution to the boll weevil problem. APHIS believes that a coordinated effort is necessary. The discussion in the EIS of the reasons this alternative was eliminated from detailed consideration has been expanded.

Limited Federal intervention was examined in detail in Alternatives 2b and 3b (eradication or suppression with limited Federal involvement). As detailed in the final EIS, the role of APHIS would be limited to detection of boll weevil populations, developing recommendations for control, supervising a post-eradication surveillance program, and environmental monitoring. Use of any control measure would be the

responsibility of the States or grower representatives. Please refer to the final EIS for further detail.

An integrated control approach was chosen as the preferred alternative (eradication) and was examined in the suppression alternative as well. As stated in the final EIS, the choice of the use of the various control methods available would be determined in response to the conditions found in a given area. This determination also extends to the choice of insecticides (out of the four examined in the final EIS) and application methods if chemical controls are to be used in that area.

A true Integrated Pest Management (IPM) alternative has been included in chapter 2 of the final EIS. The reasons why this alternative was not considered for detailed study can be found in chapter 2.

Comment 13G:

The draft EIS fails to include an objective assessment of the no action alternative. "No action" is supposed to be presented as a benchmark or baseline for comparison with the impacts of program alternatives.... The USDA evades this responsibility, however, in the DEIS by refusing to extrapolate from current practice, and instead only portrays the no action alternative in a worst case scenario.

Response: Only a general discussion of the no action (current grower practices) is possible in this programmatic EIS, due to the widely varying cotton growing conditions covered. However, appendix I, The Implementation of the Program in Alabama, contains a detailed analysis of the current grower practices in Alabama.

Comment 13H:

The draft EIS does not include a usable estimate of the current non-program boll weevil control costs for the Alabama cotton grower. In addition, while the draft EIS does contain an estimate of the projected costs of the eradication and suppression alternatives, there is no information regarding which of these costs will be attributable to Alabama and so no basis for comparison of the economic costs of the program with the current cost for the grower.

Response: This information has been included in the Alabama site-specific assessment published as a supplement to the draft EIS and now provided as appendix I of the final EIS.

Comment 13I:

The draft EIS fails to address adequately the social implications of the proposal. The USDA merely asserts in the draft EIS that the program will benefit cotton growers by leading to increased cotton production and higher profits. Nowhere does the draft EIS deal with the potential social implications stemming from opposition of cotton growers who do not support the program. Such opposition must be discussed since grower resistance can halt the program in a particular region. For example, in northern Alabama, if the growers do not approve the program by a sufficient margin in a state sponsored referendum, the program cannot be undertaken.

Response: APHIS fully acknowledges that the continuation of the program into central and northern Alabama and other areas depends upon the passage of referenda.

In past increments of the eradication program some of its most vocal opponents have, over time, become its most effective proponents. Growers in each program increment are given the opportunity to vote for or against the program. Individual ballots are not made public.

Comment 13J:

In addition, the draft EIS should discuss opposition by members of the public to the aerial spraying of pesticides over the Cotton Belt, and how that will affect the social fabric of the region.

Response: Aerial application has been used in agriculture for nearly 50 years. It is a fast, economical, and effective method for controlling the pests that threaten a grower's investment in producing a crop. Aircraft are also used to seed and fertilize some crops. "Members of the public" need to respect the grower's need to produce and protect his crop, especially when the field is soft and the cotton is mature. A discussion of the aerial spraying of pesticides has been expanded in the final EIS. APHIS operational procedures and mitigation measures have been developed to minimize the possible impacts.

Comment 13K:

We note that the Draft EIS includes no discussion of effects on endangered and threatened species from the pesticides proposed for use in various alternatives.

Response: A supplement to the DEIS has been published containing an analysis of risks and protection measures for endangered and threatened species. This supplement is appendix H of the final EIS.

Comment 13L:

The USDA has failed to analyze adequately in the 1989 draft EIS the significant potential for pesticide drift from the proposed application of large quantities of pesticides over all acreage in the Cotton Belt. The USDA includes some results of computer modeling to estimate drift, but nowhere are the results of the computer modeling integrated into the analysis of the alternatives. The potential for drift must be examined in a comprehensive and thorough fashion in the Final EIS.... The USDA glosses over the entire problem of pesticide drift stating that the mitigation proposals will alleviate this concern.... Nowhere in the draft EIS does the USDA consider an alternative that would use high volume aerial spray in lieu of ULV to minimize drift, as required by the Stipulation of Settlement.

Response: The human and nontarget species risk analyses incorporated several scenarios in which insecticide drift was the pathway for exposure. The results of these assessments are integrated into the evaluation of the alternatives. In addition, information on why high volume sprays are not feasible in this program has also been included in the chapter 2.

Comment 13M: The USDA's reliance on the mitigation measures proposed is completely misplaced. As discussed more fully below, the mitigation measures are inadequate to minimize the potential for drift.

Response: According to the analysis found in appendix B, the mitigation measures included in this EIS will minimize the potential adverse impacts of pesticide drift. Operation procedures and mitigation measures detailed in tables 2-1 and 2-2 will help minimize pesticide drift, but will not eliminate it.

Comment 13N: The discussion of effects on non-target organisms contained in Part 4 reveals that there are numerous and very significant risks posed under the preferred alternative to a wide range of non-target species. In the discussions of alternatives, however, these risks are summarized as "potential for some adverse effects ... and mitigation reduces risk to acceptable levels."

Response: The summaries of the impacts of the alternatives on various resource elements have been revised in the final EIS to reflect the results of the literature research and risk assessment.

Comment 13O: The draft EIS has not incorporated sufficient discussion of the importance of certain non-target organisms and how potential harm to those species will affect others. For example, Alabama has a rapidly growing and important commercial channel catfish industry. No mention has been made of how the program chemicals might affect this industry given drift over, or an accidental spill into, a catfish hatchery. As mentioned in other sections of these comments, attention to and specific discussion of local conditions and concerns like these, in Alabama or any other state, are lacking throughout the draft EIS.

Response: These types of local issues are addressed in the Alabama site-specific analysis and will be considered before the program moves into future increments.

Comment 13P: The draft EIS contains only a very cursory discussion of the cumulative impacts that may result from the boll weevil cooperative control program. The document fails to deal specifically with the quantity of pesticides used and only refers to cumulative effects as they relate to the activities "across the Cotton Belt," rather than discussing actual acreage involved in specific areas. What is more surprising, however, is the fact that the draft EIS fails to discuss cumulative effects within its specific alternatives, and instead only discusses the cumulative effects that it foresees from its preferred alternative.

Response: The discussions of cumulative impacts have been expanded in the final EIS.

Comment 13Q: The discussion does not include a listing of chemicals that may be used on adjoining crops and whether any synergistic effects have been uncovered between those chemicals and the chemicals approved for the

preferred alternative. In addition, the risks and uncertainties represented by the synergistic effects between chemicals are not dealt with fully or adequately. As with the discussion of cumulative effects above, the draft EIS fails to make a comparison among the various program alternatives as to whether the synergistic effects will be predictably greater or lesser, given the alternative chosen. This is an omission that must be corrected in the Final EIS.

Response: Although only limited specific data are available on this subject, the synergistic effects section has been expanded to include this data. A statement of the remaining uncertainty in this area has been added to the discussion in the final EIS.

Comment 13R: The data presented in the draft EIS regarding potential effects on groundwater lack clarity with regard to the scientific support for the conclusions given. The analyses of effects on groundwater are based on the leaching potential only, and do not consider how direct runoff might affect groundwater. The draft EIS cites a study that discussed leaching of malathion into groundwater, but apparently found no such studies on leaching potential of azinphos-methyl or methyl parathion. It appears, therefore, that the only analysis of the leaching potential for the two most toxic chemicals is derived from the GLEAMS modelling chosen for this study. Instead of merely concluding that "there is no risk to humans from leachate" the document should discuss the uncertainties of such a modelling process and should reveal the data gaps and attendant uncertainties that exist for these chemicals.

Response: This discussion has been revised to show these uncertainties in the final EIS.

Comment 13S: Other potential environmental effects, although not mentioned in the Stipulation, should have been accounted for in the draft EIS. One such effect is the potential risk posed by the so-called "inert" ingredients in the program pesticides, as well as the other adjuvant ingredients. The only one of these analyzed is xylene (for methyl parathion). These ingredients should be carefully and separately assessed.

Response: The inert ingredients in pesticide formulations are the confidential trade secrets of the pesticide manufacturers. Therefore, specific information on the components of the formulations is extremely limited. Evaluation of these inerts has been included where information was available. A discussion of this data gap has been added to the final EIS.

Comment 13T: Another environmental effect that deserves consideration is the risk that boll weevils may become less sensitive to, or develop an actual resistance to, the program chemicals. This is a risk that is conceivable given the fact that the boll weevil has developed resistance to certain chemicals, and other cotton pests have developed such resistance over the last twenty years. This risk is only briefly mentioned in the draft EIS,

and deserves greater consideration because of its importance to the question of the feasibility of eradication.

Response: The discussion of pest resistance to insecticides has been expanded in the final EIS. See the response to comment 10C.

Comment 13U:

The document fails to give a specific breakdown of the program responsibilities, specifically as they relate to the program in Alabama, namely, the state and local agencies and "cooperators" involved and how responsibilities pertain to each responsible party.

Response: The individual States and cotton growers will play a significant role in determining how the program will be operated in their jurisdiction. Specific information on how the program will be managed in Alabama may be found in appendix I, The Implementation of the Program in Alabama.

Comment 13V:

The draft EIS is devoid of any discussion of the Alabama program results, and only mentions in passing that complaints were received from area residents during the azinphos-methyl spraying operations in 1987.... The EIS must include an analysis of the results of that program to date, including current status of the program, whether it is meeting its projected timetable, and whether costs and results of the program are as predicted.

Response: These issues have been addressed in a site-specific analysis for Alabama that was published as a supplement to the draft EIS, now appendix I.

Comment 13W:

The Draft EIS does not contain an adequate discussion of the steps that can be taken to mitigate adverse effects.... The mitigation procedures proposed in the draft EIS for the Boll Weevil Cooperative Control Program are inadequate both to meet the requirements under these regulations and to satisfy the terms of the Stipulation of Settlement.... Some of the mitigation techniques suggested to protect the public seem both ludicrous and unenforceable.... Other mitigation techniques are clearly inadequate.... Equally troubling is the failure of the draft EIS to address the reasons why the previous mitigation measures that were "in force" during the 1987 and 1988 spraying failed.... The mitigation measures contained in the 1989 Draft EIS are similar to those that appeared in the 1987 draft environmental assessment that was prepared for the Southeast Boll Weevil Eradication Program. Unfortunately, in some respects, the proposed mitigation measures are less stringent than those recommended in the environmental assessment for the 1987 spraying program.... We are also disturbed to note that the mitigation techniques proposed in the draft EIS are not as protective as those agreed to by the USDA in the Stipulation of Settlement for the spraying that occurred in Alabama.

Response: APHIS believes its operating procedures and mitigation measures are sufficient to lessen any potential adverse impact of the

proposed program. As in the past eradication programs, all new programs will be locally operated and suprevised. This will insure that local conditions, such as locations of sensitive areas, will be properly addressed in the current operation. In response to comments on this issue, the discussion of mitigation measures has been revised and expanded in the final EIS.

Comment Letter Number 14

From:

Jimmy E. Pendergrass
Pest Control Technology
National Cotton Council of America
P.O. Box 12285
Memphis, TN 38182-0285

Comment 14A: NCC agrees with and supports the recommendations regarding buffer zones in that the proposed buffer widths are fully adequate for protecting environmentally sensitive areas.

Response: Thank you for your comment.

Comment 14B: Page S-1: We suggest that a more detailed description of boll weevil eradication economic benefits be presented within the summary section. Items such as grower savings per acre, decreased insecticide use, lowered threat of bollworm outbreaks, etc. The recently released USDA-ARS publication No. 621, "Economic Returns to Boll Weevil Eradication," by Gerald A. Carson is an ideal reference.

Response: In response to your comment, information on the economic evaluation has been added to the EIS in chapter 4 and the executive summary.

Comment 14C: Page S-11: Third paragraph, under Alternative 1-No Action. Reference to growers in this category using more toxic insecticides and a cause of high toxic loadings of insecticides in the soil and drift problems may be too harsh. Growers outside eradication areas are conscious of protecting the environment, but will certainly reap benefits from eradication both environmentally and economically.

Response: In response to this and other comments on this issue, the discussions characterizing the no action alternative have been revised in the final EIS.

Comment 14D: Page S-12: Second paragraph under Alternative 1-No Action. Statement that "...growers currently do not use nonchemical control methods..." is incorrect. Early maturing production systems, timely crop

termination, and stalk destruction are commonly used agricultural practices that assist in boll weevil management.

Response: In response to this and other comments on this issue, the discussions characterizing the no action alternative have been revised in the final EIS.

Comment 14F: Page S-14: Third paragraph, first sentence. Reference to the no-action alternative assuming constant exposure over a period of 30 years or longer is not supported by background information.

Response: The rationale for assuming this period of time has been added to the final EIS.

Comment 14G: Page 1-1: Last paragraph, third sentence. The boll weevil can cover a distance of at least 65 miles.

Response: This discussion has been revised in response to your comment.

Comment 14H: Page 1-2: Next-to-last paragraph, last sentence. Refers to the EIS intention to comply with a number of provisions in Stipulation of Settlement of Civil Action No. 88-H-397-N.... This sentence should read that EIS complies with provisions in stipulation of Settlement of Civil Action...

Response: Although the EIS intends to comply with the Stipulation of Settlement, a determination of compliance can only be made by the courts.

Comment 14I: Page 1-4: Figure 1-2. On map, Rolling Plains of Texas should be included as area infested with boll weevil.

Response: The maps depicting beltwide areas of infestation have been revised in the final EIS.

Comment 14J: Page 1-6: Figure 1-4. Rolling Plains area of Texas shown as noninfested by boll weevil. This is incorrect.

Response: The maps depicting beltwide areas of infestation have been revised in the final EIS.

Comment 14K: Page 2-4: Fifth paragraph, last sentence. Reference is made to mandated postharvest stalk destruction by APHIS in all eradication areas. This is incorrect for Southeastern program. Growers are encouraged and offered an incentive to destroy stalks timely but it is not a mandatory requirement.

Response: It is stated in the EIS that the States mandate this action, not APHIS. This discussion has been revised to clarify this issue.

Comment 14L: Page 2-7: Fourth paragraph, first sentence. Word "cottoonin" should be "cotton in".

Response: This typographical error has been corrected in the final EIS.

Comment 14M: Page 2-26: Fourth paragraph, second sentence. Reference to synthetic pyrethroids being "more costly" is incorrect. This class of compounds, when used at recommended rates, are the least costly class used in Heliothis control.

Response: (Refers to page 2-26, not page 2-6). Information contained in the cited reference indicates that the lower application rates for pyrethroids may not completely offset the higher prices in all cases. Other variables may be involved, such as more frequent applications.

Comment 14N: Page 2-30: Fourth paragraph, last sentence: "Chemicals available for use include malathion, azinphos-methyl, methyl parathion, and diflubenzuron." One of the stipulations in Civil Action No. 88-H-397-N is that azinphos-methyl (Guthion) not be used in Alabama eradication program. This should be addressed in a special section or appendix which provides an EIS for Alabama.

Response: A supplement to the draft EIS (now appendix I) has been published that includes a site-specific assessment of the program, as it pertains to the State of Alabama.

Comment 14O: Page 2-31: First paragraph, second sentence. Reference made to a 50 percent reduction in insecticide use during second year of program is incorrect. The Southwestern program used more insecticide during second year of program.

Response: Mr. Pendergrass is correct in stating that the Southeast, not the Southwest, program did use more insecticide in 1989 than it did in 1988. Although there were some unusual circumstances that resulted in more chemical being used, the text has been revised.

Comment 14P: Page 2-31: Fourth paragraph, first sentence. 2.5 years should be changed to 2.5-3.5 years, in order to give more flexibility in program duration.

Response: The statement is only an estimate of an average duration; the program duration may be longer or shorter in each area.

Comment 14Q: Page 3-22: Fifth paragraph, last sentence. Statement that "cotton plants can tolerate appreciable amounts of plant bug feeding before experiencing economically significant reductions in yield" may not be applicable to Delta region. See presentation by William Scott, USDA-ARS, Beltwide Cotton Conference Proceedings, 1986. His research indicates severe yield loss in field plots infested with moderate populations of *Lygus lineolaris*.

Response: This statement has been revised in response to your comment.

Comment 14R: Page 3-23: Second paragraph, second sentence. Most current research data indicate that there exists some insecticidal resistance in *Heliothis virescens* but practically no resistance among *Heliothis zea* to cotton insecticides. For information, contact Dr. Jerry Graves, Louisiana State University, 504/388-1634.

Response: Please refer to table 4-5 for referenced information on *Heliothis zea* resistance to insecticides presently used on cotton and resistance to insecticides used on cotton in the past.

Comment 14S: Page 4-72: Third paragraph, first sentence. Reference is made to production of sterile insects at the Stoneville, Mississippi, rearing facility; which should be GAST rearing facility located at Starkville, Mississippi.

Response: This statement has been corrected in the final EIS.

Comment 14T: Page 4-75: Table 4-9. Under the start date column beginning with increment 4, one year should be added to start dates through increments 4, 5, and 6. Also state that many variables determine start dates, e.g., it's possible to start West move east.

Response: The program could move from west to east, depending on grower interest and overall funding. We have added a third computation in the footnote in table 4-9 stating that further expansion from the West could reduce the proposed timetable by 5 years.

Comment 14U: Page 4-89: Table 4-17. All reference to monocrotophos under insecticides used for control should be deleted. This compound has been suspended from use on cotton by EPA. Under insecticides used for control of boll weevil, reference is made to fenvalerate, permethrin, and aldicarb. These compounds are not recommended for boll weevil control. Under insecticides used for control of bollworm, all references to endrin should be deleted. This compound has been banned by EPA for several years. Tralomethrin, cyfluthrin, and bifenthrin should be added to list for bollworm and budworm control. Under aphid list, need to add phosphamidon.

Response: Formulations of fenvalerate, permethrin, and aldicarb are labeled for boll weevil control. Table 4-17 has been revised in response to the other suggestions.

Comment 14V: Page 4-90: Table 4-17. All references to monocrotophos and endrin should be deleted.

Response: This section has been revised in response to your comment.

Comment 14W: Page 4-91: Table 4-17. All references to monocrotophos should be deleted.

Response: This section has been revised in response to your comment.

Comment 14X: Page 7-5. Jack D. Cole is incorrect, should be Jack D. Coley.

Response: This entry has been corrected in response to your comment.

Comment 14Y: Although this draft EIS addresses in a broad sense the issues of settlement agreement of Civil Action No. 88-H-397-N, site specific information should be presented which pertains specifically to Alabama. This additional information should be included as part of the EIS.

Response: In response to concern on this issue, a site-specific supplement for Alabama to the draft EIS has been published. This supplement is now appendix I of the final EIS.

Comment Letter Number 15

From:

Susan Cooper
National Coalition Against the Misuse of Pesticides
Washington, DC 20003

Comment 15A: We believe that the eradication approach should be reconsidered based on the failed historical attempts at eradication of other serious pests.... Arguments against the feasibility of eradication are not presented.... Arguments supporting the feasibility of eradication are not presented.

Response: In response to comments on this issue, information on the feasibility of eradication has been added to chapter 2 of the final EIS.

Comment 15B: The DEIS does not fulfill the requirements set forth for NEPA, under the Code of Federal Regulations (CFR) §1502.2 and 1502.14, of complete consideration of alternative methods of control.... Arguments against the feasibility of biological control are not presented.... Biological control is consistently underrated by advocates of chemical intensive agriculture.... Biological control has been extremely successful in many well-documented cases.... The feasibility of biological control and its necessary programmatic details are not presented.... Biological control is cost-effective.... A fully-staffed and funded classical biological control program has every likelihood of success at a far more reasonable cost!

Response: As stated in chapter 2 of the EIS, biological control was eliminated as a control method for detailed study because there is no indication that any biological control method developed to date can provide effective, reliable control of the boll weevil. However, it may

be an effective method against certain other agricultural pests. In coordination with USDA/ARS, APHIS continues to fund research into this important method of control.

Comment 15C:

The act of generating risk assessment numbers cloaks our ignorance of the risks with a false authority and objectivity.... Even conservative models are far too crude to provide absolute assurance of safety.... Current methods of estimating both carcinogen potency and exposure ignore the contribution of a number of factors likely to be relevant to actual human exposure conditions.... A risk assessment that incorporates sensitive populations can still allow for a disproportionately high risk in some groups.... Lifetime exposure models tend to minimize the reality of short-term exposure hazards and differences in lag-times to cancer development among populations.... Recognition and consideration of the limits of scientific certainty represents the true "worst-case" analysis, but this is rarely admitted.... Differences in professional judgment cloud the issues.... While this discussion has focused primarily on carcinogens, the same hazards of exposure and the same uncertainties with regard to chronic health effects exist for ALL of the pesticides proposed to be used in the program.... Estimates of potential environmental impacts are similarly misleading, including possible groundwater contamination.... Each individual has his or her own right to determine what they believe is an acceptable risk, and the right not to be forced or coerced into higher levels of exposure....

Response: This risk assessment used conservative estimates whenever a judgment was required to avoid underestimating any potential risks. Although risk assessment is not an exact science, it provides an indication of potential risks and is a useful tool for comparison of alternatives. Also, the risk assessment contained in the EIS examined a variety of scenarios for possible exposures of both human populations and nontarget species, including the potential for risk resulting from both acute and long-term exposures. Risk assessment is an accepted practice in the scientific community.

Comment 15D:

Malathion, azinphos-methyl, and methyl parathion have all caused a great deal of human health damage in the past.... Incidents during the pilot programs are further evidence of the damage done by these chemicals and the likelihood of many future poisoning incidents... The proposed mitigation measures are less stringent than those used during the pilot programs.... No adequate and specific provisions for enforcement of either the operational procedures or the mitigation measures are provided.... There is every indication that future harm will result under the proposed procedures....

Response: See the response to comment 13W.

Comment Letter Number 16

From:

Doyle Conner
Florida Department of Agriculture and Consumer Services
The Capitol
Tallahassee, FL 32399-0180

Comment 16: Following a review of the preliminary draft of the National Boll Weevil Cooperative Control Program Environmental Impact Statement, the Florida Department of Agriculture and Consumer Services fully endorses this environmental impact statement and would urge APHIS to finalize this document as soon as possible.

Response: Thank you for your comment.

Comment Letter Number 17

From:

Ivan J. Shields
Arizona Commission of Agriculture and Horticulture
1688 West Adams
Phoenix, AZ 85007

Comment 17A: Will full federal involvement result in a significant change in the current eradication program?

Response: Significant changes to the current eradication programs are not expected under the proposed alternative.

Comment 17B: Will the implementation of the program result in delays of treatment, trapping, etc. in the current program?

Response: See the response to comment 17A.

Comment 17C: How much input will the State have regarding any changes in the eradication program?

Response: The State of Arizona, and any other States cooperating in the program, will have input regarding changes to the program within their State, within the parameters analyzed in the final EIS. This input is provided through regular interaction between the various cooperators and annual cooperative agreements.

Comment 17D: Who will organize and lead Arizona's program cooperators?

Response: The current eradication program in Arizona began under the leadership of the cotton growers. That program has functioned successfully since 1984, and there is no change expected.

Comment 17E: Who will be Arizona's program cooperators?

Response: The cooperators in the Arizona program will continue to be:

- The cotton growers (represented by the Arizona Cotton Research and Protection Council);
- The Arizona Department of Agriculture; and
- The Animal and Plant Health Inspection Service

Comment 17F: Who will decide where the buffer zones will be or how large they will be?

Response: We assume that Mr. Shield's buffer zones refer to those areas maintained to protect eradicated areas from being reinfested. There is a possibility that a buffer zone of some description may be required along the southern part of Arizona. The program's Technical Advisory Committee will recommend the size and location of any such buffer zone. The program's Executive Committee will make the final decision regarding any buffer zone in Arizona.

Comment 17G: How will the buffer zones be maintained?

Response: Again, the Southwest Boll Weevil Eradication Program Executive Committee will determine how any buffer zone to protect eradicated areas would be maintained in Arizona. It is likely that cooperative agreements would be involved.

Comment 17H: Will the buffer zones be part of a federal quarantine?

Response: If a Federal boll weevil quarantine were to be promulgated, any buffer zones to protect eradicated areas would likely be included in those regulations. At this time, APHIS has not integrated a Federal quarantine into the program.

Comment 17I: How will the rules establishing these buffer zones be enforced?

Response: The Arizona Department of Agriculture would enforce any local regulations regarding a buffer zone to protect eradicated areas in Arizona.

Comment 17J: By what process will the buffer zones be determined?

Response: The need for buffer zones to protect an eradicated area will be determined based on an assessment of the risk of reinfestation from cotton grown in adjacent areas of Mexico.

Comment 17K: Will the Federal program require a change in the State's cotton plow-up rule?

Response: The State has regulatory authority in this program. There is no reason to expect a change in the Arizona cotton plow-up regulations.

Comment 17L: Will states which do not currently have a plow-up rule be required to implement one?

Response: APHIS would strongly encourage plow-up regulations in States involved in an active eradication program. There is a significant biological and economic basis for such regulations. The authority to promulgate and enforce such regulations rests with the State cooperators.

Comment 17M: Will cultural controls be site/state specific or beltwide?

Response: The selection of the control methods to be used in any area will be determined on a State-specific basis in response to local conditions. Any mandated cultural controls would be at the discretion of the State regulatory agency.

Comment 17N: We are concerned with mandatory participation by cotton growers. Will there be a change in the existing participation by cotton growers?

Response: The program is initiated in a given area in response to a request by the majority of the cotton growers. In responding to the growers request for boll weevil eradication, the program proposes the most effective procedures for eliminating the pest. The success of the program depends on 100 percent participation by cotton growers. Current and recent eradication activity has been based on 100-percent participation by growers.

Comment 17O: Will the grower referendum result in delays in implementing the program?

Response: The expansion of the program into new increments will be determined by grower referenda. The State legislature authorizes its regulatory agency to conduct such referenda. The regulatory agency determines when each referendum will be held. If support for the eradication program is strong, the enabling legislation and grower referendum can occur in a timeframe that does not delay program implementation.

Comment 17P: Who will determine what is a judicious use of control measures?

Response: The program's Technical Advisory Committee make recommendations regarding control measures to the Program coordinator (Director) in Arizona. The Program Coordinator then issues control guidelines to field supervisors. The field personnel who supervise the various control activities are encouraged and expected to use their own good judgement in implementing the guidelines.

Comment 17Q: Who will determine the type of response necessary for existing pest conditions?

Response: As mentioned in the response to the previous comment, the Technical Advisory Committee, the Program Coordinator, and the treatment supervisors work together to determine the best response to specific pest situations in Arizona.

Comment 17R: Who determines whether the environmental concerns outweigh the pest risks?

Response: Field supervisors under the direction of program managers will weigh environmental concerns against local pest risks.

Comment 17S: If the availability of the preferred chemical becomes limited, will alternative chemicals be allowed?

Response: The final EIS evaluates the use of four program chemicals. APHIS will be limited to these four chemicals at this time. If additional materials are considered in the future, they will first have to be analyzed in similar fashion as in the final EIS.

Comment 17T: Who will do the supervising and monitoring?

Response: Responsibility for supervising and monitoring may vary from one State to the next in accordance with the State's level of involvement.

Comment 17U: Who will pay for chemical analysis?

Response: The expense of analyzing chemicals would be shared by all cooperators.

Comment 17V: Who will be responsible for litigations resulting from chemical applications?

Response: Certified applicators are responsible for the treatments they apply. Ultimately, liability is determined by the courts.

Comment 17W: Who will determine the economic threshold?

Response: The Technical Advisory Committee determines the economic threshold with significant influence from the local Extension Service.

Comment 17X: Will the economic threshold be site/state specific or will it be beltwide?

Response: Economic thresholds are usually consistent across an entire program increment. Factors considered include:

- Program logistics
- Communications
- Assessment structure
- Crop protection practices
- Boll weevil pressure

Comment 17Y: Will a cooperative agreement be necessary to assure compliance with state and federal rules?

Response: Yes. Cooperative agreements are required for each new program increment.

Comment 17Z: Treatment should be conducted at night prior to 7 a.m.

Response: Program treatments could be applied at night, depending on local regulations, conditions, and crop protection practices.

Comment 17AA: Who will be responsible to notify bee keepers? They must be notified before 48 hours of the application.

Response: Bee keepers will be notified in accordance with State law and pesticide labeling. Notification may be given by the field supervisor, an officer-in-charge, or cooperating State personnel.

Comment 17BB: How will targeted pests on cotton which is within 500 feet of a crop not on the chemical label be treated?

Response: Operational procedures and mitigation measures provide that application aircraft shall avoid direct spray of adjacent crops at all times. Treatment procedures are adjusted and timed to minimize the potential for drift towards other crops. If this is not feasible, ground equipment can often be used to increase the margin of safety.

Comment 17CC: How will targeted pests on cotton which is around sensitive areas be treated?

Response: Treatment procedures can be adjusted and timed to minimize potential for drift toward a sensitive area. Growers are strongly encouraged to avoid planting cotton near sensitive areas. If such cotton is planted and becomes infested with boll weevils, it must be treated carefully.

Aerial applicators can work at a lower altitude, rotate their spray boom toward the rear of the aircraft, and only work in calm conditions. These adjustments result in larger, heavier droplets with a shorter distance to travel, and significantly less potential for drift. In some cases this use of treatment aircraft will be restricted.

If program personnel have significant concerns in a specific area, ground equipment often can be used to increase the margin of safety.

Comment 17DD: Will there be federal funding for the purchase and application of the chemicals?

Response: Cooperative agreements between the various program participants will describe how funds will be used. The expense of purchasing and applying chemicals is frequently shared by all program cooperators.

Comment 17EE: Will treatment on Indian reservations be the same as non-reservation lands?

Response: Indian reservations are considered sovereign nations, and the program works with each one individually.

Comment 17FF: Will cultural controls be enforced on both Indian reservation and non-reservation lands?

Response: Reservations establish and enforce their own cultural controls.

Comment 17GG: Will tribal agreements be required? Will these agreements be between the tribe and state, the tribe and federal government, or the tribe, state, and federal government?

Response: This depends on the tribe. In some instances they participate as a cooperator without a formal agreement, while in other instances the tribe may desire a formal cooperative agreement. Any agreement could be with the State or Federal government. Most agreements are usually with the State.

Comment 17HH: Will the federal government be responsible for any litigations resulting from the program? If not, what will they be liable for? If the state is responsible for litigations, will the federal government assist in any way?

Response: Should it become an issue, liability is determined by the courts.

Comment 17II: Will the federal government assist in the insuring of applicators?

Response: Contract applicators are required to provide proof of insurance. APHIS will not assist in insuring applicators.

Comment 17JJ: Who sets the size and boundaries of the manageable increments?

Response: APHIS, the Boll Weevil Technical Advisory Committees from the various States, and the cotton producers will determine the size and boundaries of each program increment. The National Cotton Council plays a significant role in coordinating this process.

Comment 17KK: If a manageable increment includes two or more states, who will coordinate activities between them? Who will resolve disputes?

Response: Differences between participating States can be resolved in several ways. If an areawide grower foundation is established, as in the Southeast, the foundation's board of directors resolves any differences of opinion. In the Southwest the program's Executive Committee, representing all program cooperators, resolves any such differences between States.

Comment 17LL: Will quarantines between two states be superseded by a program-wide federal quarantine?

Response: Individual States establish their own regulations regarding boll weevil eradication. As the weevil is eradicated from additional States, these local regulations may become difficult to manage. If this happens, there may be future justification for promulgating a Federal boll weevil quarantine.

Comment 17MM: Who will conduct the surveys for candidate, threatened, and endangered species? Who will determine if a survey needs to be conducted? Who will pay for these surveys? What process will be used to determine the type of survey to be conducted? Will the cost of a survey be a determining factor as to type or method of treatment? Will the cost of a survey be a determining factor as to whether a program is done? What are the alternatives to doing a survey? What is the process for justification of having to do a survey? What process is there for challenging should a survey be needed? If the species is going to be delisted or downlisted, is a survey needed?

Response: Consultation with the Fish and Wildlife Service will determine the need for surveys. If the program is required to perform such surveys, the expense will be part of the cost of the overall program and will be shared by all cooperators. Cooperative agreements would determine who actually conducts such surveys. Program coordination and management has been added to the final EIS.

Comment Letter Number 18

From:

John W. Impson
Office of Agricultural and Environmental Sciences
Louisiana Department of Agriculture
P.O. Box 3118
Baton Rouge, LA 70821-3118

Comment 18A:

If I read correctly, APHIS will provide no funding support for cultural control (Table 4-8). Since stalk destruction is a primary component in the program (Table S-1), it seems inconsistent and, frankly, unwise to provide no incentive for effective cultural practices. Trap cropping, a control tactic not considered in the Preferred Alternative, seems to have been eliminated more on the basis of grower unpopularity than on merit. Strongly encouraging grower participation in this cultural practice provides an environmentally sound attempt to reduce the need for more complex options such as sterile release and production limitation, both of which seem less feasible or likely to contribute to control than trap cropping. Destruction of field and adjacent overwintering brush (where possible), coupled with pheromone monitoring of trap crops in the spring, would provide prime opportunities to target incoming adult boll weevils. The current Draft deemphasizes cultural methods, leaves funding incentives to individual states, and clearly favors a continued return to heavy reliance on chemical control.

Response: During an eradication program there is benefit in the timely destruction of stalks immediately after cotton has been picked. Although APHIS does not provide direct funding to support this activity, the current program frequently does offer growers financial incentives for the early destruction of stalks. Early stalk destruction can save the program the cost of several treatments late in the season and reduce potential overwintering populations of boll weevils. Incentives offered in the current program have involved credit toward the growers' assessment the following year.

The benefits of trap cropping are not as easy to quantify. It would be difficult to determine how many treatments had been avoided as a result of a grower's trap crop. The logistics of monitoring the planting, maintenance, treatment, and destruction of trap crops over a 1 million-acre program increment would be prohibitive. Effective cultural control practices are usually endorsed by local Extension Service and research personnel. Individual States will determine whether they want to mandate and enforce such practices as part of an areawide control effort.

Comment 18B: The EIS does not specifically address the increased development of organophosphate resistance by secondary pests to the selected insecticides.

Response: Discussions of insecticide resistance have been expanded in the final EIS.

Comment 18C: No mention of pyrethroids was made in the Preferred Alternative, possibly due to their assumed use on mid-season secondary pests. Is this why they are completely eliminated in the Draft? Very limited use of a pyrethroid (e.g., on a trap crop or in a single rotation schedule during the season) might still be considered.

Response: Several of the pyrethroids provide varying degrees of suppression when used for boll weevil control. None of those materials, however, are more effective than the organophosphates analyzed in this document. Pyrethroids were not analyzed for use in an eradication program because:

- They are no more effective in controlling the boll weevil than the noted organophosphates;
- The Extension Service and cotton growers have strongly recommended limiting the use of pyrethroids, especially early in the season, because of concerns over other pests developing resistance to these materials;
- Considering the treatment intervals used in controlling the boll weevil, pyrethroids used alone may be more costly.
- Of the various materials analyzed for boll weevil control, it was reasonable to limit the number that were analyzed in a document of this detail.

Comment 18D: The need for more information on synergistic pesticide interactions (referred to on 4-88) is crucial and seems vital to successful execution of this overall program.

Response: The information on synergism as presented in chapter 4 summarizes all available data on that topic for combinations of the proposed program insecticides and all other pesticides. Because there is limited information on this topic, it has been listed as a data gap in the final EIS.

Comment 18E: As a state regulatory person I am concerned with the ambiguous nature of the essentially unstated federal and state responsibilities (who does what, where, and when). Few specific responsibilities of these two entities are addressed in the Draft.

Response: The specific responsibilities of State and Federal cooperators in a boll weevil control program are purposely not defined in this document.

Cotton is produced in 17 different States. The boll weevil has been eradicated from five States and is in the process of being eradicated from three others. Future eradication activity could occur in another nine States.

State and Federal cooperators have assumed a variety of responsibilities during past and current boll weevil eradication activities. The situation in each State is different, and the program allows for that difference. Some States are in a position to assume a greater share of the responsibility for conducting the program, and they have a desire to do so. Other States limit their participation to collecting grower assessments and providing regulatory enforcement. The legislature in some States appropriates funds to offset grower assessments and even provide personnel, while other States make no such appropriation.

In an effort to be sensitive to local conditions, desires, and State authority, APHIS will not dictate the specific responsibilities of the program cooperators. Responsibility for the various actions described in the EIS is determined prior to expansion into each program increment. All cooperators enter into cooperative agreements which define their respective roles and responsibilities. The program does not begin until these agreements are completed and specific roles and responsibilities are understood.

The success of recent eradication efforts can be attributed, in part, to the program's flexible design. APHIS would like to maintain that flexibility in future programs.

Program cooperators can communicate regularly through the National Cotton Council's Beltwide Boll Weevil/Cotton Insects Action Committee and locally established Boll Weevil Eradication Technical Advisory Committees within each State.

Comment 18F:

What will occur, should one or several states fail to enact the appropriate legislation to accept and implement the final program? Will APHIS assist in legislative approval to support unanimous participation by states, without which the total concept of a regional control program is dealt a serious blow?

Response: If one or several States fail to enact enabling legislation, the eradication program would end.

APHIS will not interfere with State legislatures. If local growers support the program strongly enough, they will generate the necessary support from their State legislators.

Comment 18G:

I do share the opinion of others voiced in the scoping process regarding the term "eradication," and believe concern #2 (details of program operation) and #4 (total grower support) (C-2) still need to be further explored.

Response: A discussion of the feasibility of eradication, along with APHIS' definition has been included in chapter 2.

Concerns regarding "details of program operation" have been addressed in response to Comment 18E.

The context of the concern over the requirement for "total grower support" involves the pitfalls of designing an areawide control program without 100 percent grower participation. Because of the boll weevil's high biotic potential, a few poorly managed fields can easily infest any cotton grown within a radius of up to 85 miles.

Therefore, if an eradication program is to be successful, it must include all the growers in a specific area.

Comment Letter Number 19

From:

Larry B. Goldman
Fish and Wildlife Service
U.S. Department of the Interior
P.O. Drawer 1190
Daphne, AL 36526

Comment 19A:

This responds to your August 31, 1989, request for comments regarding the draft of the National Boll Weevil Cooperative Control Program Environmental Impact Statement (EIS). This office has already provided comments on this proposed program via your informal endangered species consultation with our regional office in Atlanta, Georgia. We understand that you are in the process of initiating formal consultation with the Fish and Wildlife Service regarding the EIS. This office will again provide comments coordinated through our Atlanta office.

Response: Please see comment letter 25 and the accompanying responses.

Comment Letter Number 20

From:

Richard E. Caron
Agricultural Extension Service
The University of Tennessee
Institute of Agriculture
605 Airways Boulevard
Jackson, TN 38301-3201

Comment 20A:

Chemical control is limited to only four insecticides. Growers may use less toxic materials for boll weevil control than methyl parathion or azinphos-methyl. There is some interest in less toxic materials for the safety of the applicator although methyl parathion and azinphos-methyl are relatively less expensive.

Response: The discussions evaluating the no action alternative have been revised in the final EIS. Also, detailed information on mitigation measures and operating procedures to protect the health of workers has been incorporated.

Comment 20B:

The nonchemical control alternative may be expanded on an economic basis to explain why this alternative will not be considered. Estimated costs in yield reduction under nonchemical control versus maximum yield with insecticide control may be considered here.

Response: A detailed analysis of this option was not undertaken because eradication or suppression of the boll weevil throughout the cotton belt is not considered technically feasible without some use of chemical insecticides.

Comment 20C:

A more extensive review of the effects of severely cold winters and severely hot and dry summers on boll weevil mortality should be noted. How would these scenarios affect the program and its economics and environmental impact?

Response: Additional information on how climate affects the boll weevil with the association effects on the program, its costs, and potential environmental impact has been added to chapter 1.

Comment Letter Number 21

From:

Richard E. Sanderson
Office of Enforcement and Compliance Monitoring
U.S. Environmental Protection Agency
Washington, DC

Comment 21A:

This EIS should evaluate a wide range of alternatives, including combinations of techniques that incorporate Integrated Pest Management methods. Biological controls, cultural practices, and new chemical formulations should be fully analyzed as potential alternatives.

Response: All control methods that have proven to be feasible based upon their effectiveness and reliability against the boll weevil have been incorporated into the final EIS.

Comment 21B:

The EIS should set forth provisions for the actual administration of the boll weevil eradication program. The responsibilities of the cooperators should be described, with assurances that the program will be carried out as explained in the EIS.

Response: See the response to comment 18E.

Comment 21C:

The document states, Table 2-2, number 4, that the program will be adjusted to protect sensitive areas such as water bodies and public areas. How will the program be adjusted to avoid negative impacts to these areas?

Response: Further information on mitigation measures has been incorporated into the final EIS.

Programmatic designed buffers are likely to hinder the achievement of the goal of eradication. In many instances, ground equipment will be used adjacent to sensitive areas in lieu of buffers.

Additionally, APHIS will comply with State-mandated buffers (see chapter 5) and will discourage growers from planting cotton in areas that cannot be treated. APHIS believes that site-specific attention to local areas of concern will be more effective in reducing risks than beltwide prohibitions.

Site-specific analysis will be prepared, as necessary. Should the analysis indicate the need for mitigation, it will be required.

Comment 21D: The DEIS lacks any consideration of risks to marine and estuarine species. The document should consider the importance of estuarine areas to breeding, spawning, and nursery habitat for commercial species.

Response: Because the presence of this type of habitat adjacent to cotton is limited, impacts such as these will be examined on a site-specific basis.

Comment ID 21E: The role of sediments in transporting and degrading the pesticide, or maintaining the toxicity of the pesticides, has not been adequately addressed.

Response: Information on this subject has been added to the final EIS in response to your comment.

Comment 21F: The document should discuss the fate of chemicals that adsorb to suspended particulates. Particularly, the draft should clarify the implication that the chemicals adsorbed to particulates are removed from the system. These chemicals are reintroduced slowly or enter the food chain as they are consumed by organisms. Dredging and open-water disposal can resuspend sediments, further distributing contamination.

Response: Information on the fate of program chemicals adsorbed to sediments has been added to the final EIS in response to your comment.

Comment 21G: The document should address how specific control methods will be chosen for each type of site. If pesticides are to be used, what criteria will be used to assess which pesticide product will be chosen and when they will be applied?

Response: Regarding treatment decisions, each cotton field is considered individually.

When the number of boll weevils captured in a specific cotton field exceeds an established threshold, control operations must begin. Several criteria are used to determine the appropriate method of control:

- The number of boll weevils captured
- The size of the field
- The distribution of the weevil population within the field
- The physiological stage of the cotton crop; its susceptibility to weevil damage
- The status of secondary pests and beneficial insects

- Control methods available; cost and efficacy of each
- Methods of application
- Treatment availability and timeliness
- Wildlife resources, including threatened and endangered species
- Various consequences of treatment

Program funds are limited, and treatment decisions are made carefully.

Comment 21H:

The final EIS should include detailed guidelines regarding the control methods used to set a general framework upon which site-specific plans could be implemented. Site-specific environmental analyses consider local factors such as soil and hydrological conditions, risks to wildlife and human health, and cumulative effects before selecting an appropriate method of control. Each environmental analysis should also define appropriate monitoring systems for the treated area.

Response: The description of control methods within each alternative establishes general guidelines for the implementation of site-specific plans.

Comment 21I:

The program must provide local managers sufficient guidance to make environmentally sound decisions regarding control methods, particularly if pesticides are to be used. Of special concern is that the program emphasizes the use of many applications of pesticide based on the number of boll weevils on the site. Other control methods should be incorporated into the site-specific plans. A management plan could incorporate a risk-based decision matrix that would enable field personnel to select the least environmentally disruptive combination of cultural, physical, biological, and chemical control measures for a given site.

Response: The program describes the need to apply effective methods of control when the boll weevil population exceeds an established threshold in a specific cotton field. If pesticide treatments are applied, they are not at the exclusion of clean field borders, short-season varieties of cotton, or early stalk destruction. Boll weevil eradication requires a variety of control methods. Some are employed by the program, others are at the discretion of the individual grower. Only those alternatives and control measures analyzed in the EIS will be available at the site-specific level.

Comment 21J:

Implementing a successful program depends on eradicating the boll weevil on a geographical continuum. While the program proposes to eradicate the pest in incremental steps, there are circumstances in which patches of untreated areas may allow recontamination. These circumstances might include lack of grower participation, restrictions to protect endangered species, or resistance to eradication. What steps

will be taken to ensure that these patches will not result in recontamination of eradicated areas? Have contingency plans been developed in case portions of the program do not occur or must be altered?

Response: The eradication program will not expand into a new increment unless State law and a grower referendum have resulted in participation by all cotton growers.

Cotton may occur in sensitive areas that cannot be treated with pesticide. Such areas will be considered individually. Growers will be encouraged to avoid planting in these sensitive areas, and some States may actually prohibit such planting. Cotton planted in prohibited areas will be handled by local regulatory officials. This action would be taken to protect the sensitive area and to prevent a few poorly managed fields from infesting a significant portion of the program area.

In instances where cotton is planted near a sensitive area, but State law has not been violated, alternate control methods will be considered.

Comment 21K:

In some cases weevil populations may not be totally eradicated in infested areas. In fact, the Southeast Eradication Program, as described in the EIS, has not resulted in total eradication of the pest. What measures will be taken to monitor these reinfestations and how will they be controlled? How will boll weevils from Mexico be stopped from recontaminating the States?

Response: When cotton is grown for an entire season with an adequate array of pheromone traps and no boll weevils are detected, we consider that production area to be weevil-free.

The Mexican cotton that occurs near the United States border has been or will be included in boll weevil eradication efforts. Several of these areas are already weevil-free, and growers in the other areas, like Caborca, are likely to participate in an eradication program. Once these pockets of infestation are eliminated along the border, a natural buffer will separate the United States from the infested areas to the south. The border will be continually monitored to prevent reinfestation.

Comment 21L:

EPA recommends that encapsulated methyl parathion and azinphos-methyl not be used because of their high toxicity. Elimination of these two products will reduce losses of non-target species and contamination of water, while decreasing the risks to applicators and the general public.

Response: Encapsulated methyl parathion and azinphos-methyl are both registered for use on cotton for the control of the boll weevil. Both are products commonly used by growers and were analyzed due to their feasibility as control methods. Mitigation measures, as well as compliance with label requirements as set out under FIFRA, will help to reduce risks that may result from these two insecticides.

Comment 21M:

The document should assess and mitigate the inadvertent loading of local and regional hydrological systems with pesticide runoff. This loading is very bothersome considering the close proximity of cotton fields to ponds and streams in the south and irrigation systems in the west. Of particular concern is that exposure to estuarine systems may actually be greater than levels estimated using the models cited in the draft because of the potential for concentrating contaminated sediments in estuaries and the potential for direct pesticide runoff and drift into these areas. APHIS should assess the effects of pesticide use on all water sources. Mitigation should be provided to ensure that the water quality of any source will not be impacted by insecticides and their products. The EIS should discuss the guidelines used in project planning to ensure that surface and ground waters are protected from aerial spraying and runoff.

Response: Mitigation measures and operating procedures have been specified in the final EIS. Runoff into rivers was examined in the original DEIS. Runoff into farm ponds has been added as a scenario in the final EIS. Impacts on estuaries will be evaluated in site-specific assessments, as necessary.

Comment 21N:

The document states that the selection of a particular pesticide will be based on environmental and economic considerations. These considerations should be detailed in the final EIS.

Response: The economic factors that are considered in selecting a pesticide are based on per-acre cost.

The environmental factors that are considered in selecting a pesticide are very complex. Some of these factors include:

- The density of cotton in the specific geographical area
- The relative size and accessibility of each cotton field
- Sources of water in the general area and their proximity to cotton
- Population density in the general area
- The number and nature of sensitive sites within the general area
- The results of the Endangered Species Act (ESA) section 7 consultation with the Fish and Wildlife Service regarding species of concern in or near the general area
- The chemical properties of the various materials and differences in risk potential
- Potential health effects on workers and applicators

- Time of year during which treatments will be applied and stage of crop development

- History of each material's use in the general area

These and other factors are considered when selecting a specific pesticide for use in the eradication program.

Comment 21O:

The document should address the amount of pesticides that will be applied. Since threshold numbers for boll weevils determine when pesticides will be applied, will applications continue as long as the boll weevil is present or will there be a limit to the number of applications made on each geographic area?

Response: The amount of pesticide applied to a specific cotton field is determined by the degree of infestation. In the many fields where the treatment threshold is not exceeded, no pesticide will be applied. In heavily infested fields, treatments are applied to prevent economic damage to the crop and to break the boll weevil's reproductive cycle. In those fields, treatments are applied until the number of weevils trapped is fewer than the threshold. These treatments are applied in accordance with EPA- and State-approved label instructions. Program treatments will occur for two to three seasons, with significantly fewer fields requiring treatment in the second and third years.

In the absence of an eradication program, the number of grower-applied treatments would be limited only by label instructions and personal finances. There would be an ongoing, annual need for such treatments.

Comment 21P:

The final EIS should identify standards and guidelines for making decisions about the use of pesticides including the following decision criteria: soil type, slope, precipitation (amount, type and distribution), temperature, application (method, rate, and amount), repeated or combined applications, proximity to ground water or surface water and stream/ground water monitoring requirements. Pesticide use as a control measure should also be based on timing the application to when the boll weevil is most susceptible to insecticides, i.e., at critical life stages of the pest.

Response: The models run as a part of the overall risk assessment have considered most of the criteria mentioned in the comment. Worst case scenarios have been analyzed and mitigation measures and operating procedures developed. Pesticide applications are timed to have maximum effect on the boll weevil population.

Comment 21Q:

Since the regulatory status of chemicals is constantly changing, APHIS should review the current status of all pesticides considered for use prior to each application season. The final EIS should describe a plan to ensure these measures are taken.

Response: The program will comply with the current Federal and State laws regarding the use of pesticides. Revisions have been made in the operating procedures to ensure that an ongoing review of current laws and regulations be required.

Comment 21R:

It is not unusual for the public to become alarmed at the prospect of an extensive pesticide application program, especially in those areas where agricultural lands border residential areas. Consequently, the final EIS should describe and commit to a program to verify compliance requirements. If the pesticide application is well monitored and documented for compliance, and that information made available upon request, the public can often be reassured that no unreasonable risk has occurred to their health or environment.

Response: The economical production of cotton in the boll weevil-infested parts of the United States has required the application of pesticides since 1916. Controlling the weevil in these cotton-producing regions is a way of life. This program proposes no significant changes to current practice, it merely combines several components of control into an effective and coordinated areawide approach. Monitoring plans have been in effect for all current and past eradication programs and will be implemented in all future program increments.

All applicators are already licensed and regulated by State agencies. Contract applicators are also trained concerning program activities, and their treatments are monitored by program personnel.

Comment 21S:

The EPA will be issuing final worker protection standards by the end of 1989. These regulations cover requirements for those persons storing, mixing, loading, applying, and disposing of pesticides. The final EIS should discuss provisions to ensure these worker protection standards are met.

Response: As of publication of the final EIS, this rule is not final. APHIS will review the rule and ensure its own worker protection standards are no less stringent than EPA's.

Comment 21T:

While the document asserts that there will be minimal potential for significant groundwater contamination, the DEIS fails to consider the cumulative impacts attributable to simultaneous treatments over one geographic area or successive spraying over several years. These impacts overlap in space and time so that the effects are not dissipated.

Response: The discussions of cumulative impacts have been revised and expanded in the final EIS to incorporate considerations such as this.

Comment 21U:

The program calls for extensive spraying of areas at much greater frequency than usual for the products to be used, up to 25 times the first season in heavily infested areas. Greater residue levels in soils and

water would be expected. Although the pesticides considered for the program generally degrade quickly, there is a great potential for long-term chronic toxicity to non-target species. The final EIS should address how cumulative effects of multiple applications can be minimized.

Response: The program does not call for "extensive spraying of areas at much greater frequency than usual." The program calls for each cotton field to be treated as often as necessary to eliminate the boll weevil. Individual fields with a history of heavy weevil infestation usually receive multiple treatments each season by producers. The only difference is that once the program begins, program personnel now supervise those applications.

It is acknowledged that the most heavily infested fields may receive more treatments than they would if they were not in the program. Historically, such fields have only accounted for about one field in every 1,000 acres.

Comment 21V: The document should address the cumulative effects of pesticide programs of other agencies and organizations that may overlap with the Boll Weevil Program.

Response: The discussions of cumulative impacts have been revised and expanded in the final EIS.

Comment 21W: EPA believes it is necessary for APHIS to describe in detail the monitoring plan for evaluating the environmental consequences of the Boll Weevil Cooperative Control Program. Criteria should be described for determining the effectiveness of the control methods and their effect on the environment.

Response: Information on monitoring plans has been incorporated into the final EIS.

Comment 21X: Detection of boll weevil numbers is critical to determining whether chemical treatment will be needed and if additional treatment is necessary to block reinfestation. The monitoring of boll weevils should anticipate erratic changes in population numbers due to climatic influences, wide dispersal rates, and delayed outbreaks. In extreme situations it may take many generations or even years, for a suppressed population or a reinfestation to reach detectable levels. Consequently, APHIS should devise a monitoring system that incorporates adequate testing methods, such as using grid systems and high trap densities over an appropriate period of time.

Response: Further detail on the methods to be used for detecting reintroductions has been provided in the discussion of program management, specifically post-eradication.

Comment 21Y:

Measures were described in the document that mitigate for the protection of workers, the public, and bees. Measures should also be developed to protect other non-target species and other natural resources.

Response: Information on mitigation measures to protect nontarget species and other natural resources has been incorporated into the final EIS. The success of the program ultimately results in the long-term protection of natural resources.

Comment 21Z:

The standard procedures of the program should include descriptions of protective measures to avoid contamination of water systems. For instance, use of buffer zones between cotton fields and sensitive areas.

Response: Detail on mitigation measures to protect various environmental resource elements has been incorporated into the final EIS.

Comment 21AA:

Since the program will have potentially harmful effects on endangered and threatened species, APHIS should elicit from EPA comments on the biological assessment that describes the control alternatives. EPA encourages APHIS to consult with the FWS and the Office of Pesticide Programs in EPA to determine what mitigative steps should be taken to avoid jeopardizing the continued existence of endangered species. The EPA's Endangered Species Protection Program is to be implemented by January 1991 with voluntary compliance in the interim. APHIS should incorporate the protective measures before the 1991 implementation date. The document notes that federal candidate species have no protection under the Endangered Species Act and that safeguards to protect these species will occur only after they are listed. EPA suggests that special considerations be made to protect these species from control measures. While no legal requirements exist, these species should be considered sensitive to the program's activities and therefore should be afforded special attention.

Response: Under the Endangered Species Protection Program, Federal agencies may consult with the Fish and Wildlife Service to obtain a biological opinion specific to a particular Federal action, in this case, the boll weevil program. APHIS in consulting with the Fish and Wildlife Service and will comply with the protective measures contained in the biological opinion.

Comment 21BB:

Page 4-26, paragraph 3: The document states that malathion showed "...no effects on wildlife...in a field study...in areas sprayed at 0.425 lb active ingredient per acre..." This lends little support that the malathion application rate of 1.14 or 1.22 lbs active ingredient per acre will have no detrimental effect on the environment.

Response: This was the only field study of effects on wildlife with malathion that was available for review. The statement in chapter 4

has been revised to reflect the differences in application rates in the two situations.

Comment 21CC:

Page 4-36, paragraph 3: No significant adverse effects of the use of malathion were cited for rates lower than those planned for the program (1.22 lbs/acre), but only brief mention is made of a field study that reported severe effects to populations of amphipods. The final EIS should clarify whether malathion will have significant adverse effects at the rates planned for the program.

Response: This section has been revised in response to your comment.

Comment 21DD:

The document suggests that malathion will pose little hazard to aquatic invertebrates because control programs for mosquitos and rice and sugar cane pests have had no effects on various crustacean species. However, there is no direct comparison of rates of application in the studies cited and those proposed for boll weevil eradication.

Response: This section has been revised in response to your comment.

Comment 21EE:

Page 4-30, paragraph 4: The description of non-target species exposure analysis defines a typical dose as occurring by ingesting 5% of contaminated diet items. There is no indication of the rationale behind this assumption. Since it is likely that higher percentages of food items would be contaminated, the risk analyses may underestimate the effects of ingested insecticide.

Response: Chapter 4 of the draft EIS contained an inaccurate description of the methodology used in the nontarget species risk assessment. This has been corrected in the final EIS.

Comment 21FF:

The note at the bottom of Table 4-3 on estimated risks to non-target species does not conform to the Q-value figures for risk to aquatic species on the preceding page. Since actual risk values are absent from the discussion in this section, true risk values are impossible to determine. This table should be represented by pointing out that highest risk levels are estimates and that actual risks may sometimes be higher. Also, since the estimates refer to generic groups of species, risks to individual species might be much higher.

Response: The risk assessment has been revised and no longer uses Q values. The table is only intended to provide a basic summary of the nontarget species risk assessment. A reference has been added to direct the interested reader to appendix B7 for quantitative information.

Comment 21GG:

Although estimated environmental concentrations resulting from runoff were determined for five specific rivers, apparently no consideration was given to runoff into pond ecosystems. If standard EPA runoff and drift models are used, the loading values are about an order of magnitude greater than those presented in the EIS. These higher values alter the assessments of risk for many non-target species.

Response: A scenario evaluating risks from runoff into ponds has been added to the wildlife risk analysis.

Comment 21HH: The authors of the EIS have had to use avian species as surrogates to extrapolate the toxicity of various insecticides to reptiles and adult amphibians. The use of avian species to determine effects on reptiles and amphibians may be questionable. Many examples exist where closely related species have widely differing tolerances to a given pesticide. Comparisons between species and between classes may be on shaky ground.

Response: The rationale for this procedure is outlined under "Surrogates for Amphibian and Reptile Toxicity" in appendix B7.

Comment 21II: The EIS is deficient in regards to risk assessment for endangered species. Lists of endangered and threatened species are provided but the EIS does not describe in detail how the program may affect these species.

Response: APHIS has entered into formal consultation with the Fish and Wildlife Service to protect endangered and threatened species. APHIS also has published a supplement to the draft EIS detailing the analysis of effects to endangered and threatened species, now incorporated in the final EIS as appendix H.

Comment Letter Number 22

From:

Charles J. Galley, Jr
Agricultural Division
American Cyanamid Company
One Cyanamid Plaza
Wayne, NJ 07470

Comment 22A: We strenuously object to the carcinogenic risk assessments performed for malathion.

Response: Because this is a conservative risk assessment and the malathion metabolite malaoxon appears to present a possible risk of carcinogenicity, a cancer risk analysis for malathion was conducted.

Comment 22B: Page 4-50: The LD_{50} in rats (370 mg/kg) for malathion quoted in the EIS is incorrect. This data was generated by intraperitoneal injection rather than by conventional oral dosing.

Response: This discussion has been revised in the final EIS.

Comment 22C: Page 4-60, Risk of Mutagenic Effects: To state in the EIS that malathion may be a weak inducer of chromosomal damage is not defensible in that there is insufficient data to allow one to make such a conclusion.

Response: This section has been revised in response to your comment.

Comment 22D: Page B2-15, Immunotoxicity: The statement in this section that malathion is a dermal sensitizing agent is not correct. Data presented in the Toxicology Chapter of the Malathion Registration Standard show that malathion is not a sensitizer. The data cited in the toxicology chapter is from standardized dermal contact sensitization procedures. Data cited in the EIS is from nonstandard studies in which malathion was injected intradermally into animals to elicit a sensitizing response. To determine the potential for dermal sensitization, all products evaluated in the EIS should be evaluated with a method approved and standardized by EPA.

Response: The analysis in this EIS does not rely solely on EPA sources for information on the toxicity of these insecticides. The information presented is an accurate summary of the information in the available literature.

Comment 22E: Page 2-17, Table 2-3, Insecticide Trade Names: Active ingredients – the chemical name for malathion is not correct. It should read o,o-dimethyl phosphorodithioate of diethyl mercaptosuccinate.

Response: This has been revised in response to your comment.

Comment 22F: Page 2-17, Table 2-3, Insecticide Trade Names: Under "Application Method" make the following changes for Cythion RTU...ULV aerial/ground equipment; Cythion...ULV aerial/ground equipment; Fyfanon...ULV aerial/ground equipment.

Response: The application methods in this table are only those that APHIS proposes to use for each of the formulations. The table is not intended to list all methods allowed on the label for each formulation.

Comment 22G: Page 2-18, Malathion, third paragraph and page 4-9 second paragraph: The half-life value for malathion (25 days) taken from Knisel et al. 1987 is not correct. This value was not correctly stated by these authors. Please contact Dr. R.A. Knisel for verification at (912) 386-3291.

Response: This value was incorrectly reported in chapter 2 of the draft EIS and has been corrected in the final EIS. The soil half-life has been changed in response to your comments and the value used in the environmental fate modeling for the final EIS was 3 days, as stated correctly in table B8-8 of appendix B, section B8.

Comment 22H: Page 4-9 and 4-3,4, Malathion Fate in Soil: These sections give several references for half lives of malathion in soil. Malathion is referenced to have half lives of 0.5 and 1.0 days. Other references quoted in the EIS

state malathion half lives ranging from 7.5 to 11 days in rangelands low in organic matter. Finally, page B4-3 states that "degradation by enzymes in soil humus is the most rapid process; malathion is rapidly degraded in moist soils with significant organic content". All cotton grown in the USA is on improved land with significant moisture and organic matter to make a crop. The half life value of 0.5-3 days should be used in the EIS assessments instead of the value of 7 days which is more typical for rangelands low in organic matter not suitable for cotton production.

Response: The malathion soil half-life has been changed to response to your comment. A half-life of 3 days is used in the final EIS.

Comment 22I: Page 4-26, Hazard Analysis, Malathion: The highest labeled rates for malathion technical for mosquito control (0.231 lb ai/A-aerial and 0.0769 lb ai/A-ground) have not caused moderate or high mortality of mosquito fish or striped bass. Malathion has been used extensively in the United States as a mosquito adulticide for over 2 decades with no incidences of fish mortality reported when used according to label instructions. This generalization in this EIS should be reworded.

Response: This paragraph has been revised to provide specific information on this topic.

Comment 22J: Page 4-88, Synergistic Effects: EPN, parathion, and trichlorfon are either no longer registered for use on cotton or their usage is extremely limited on cotton.

Response: This discussion has been revised to reflect the current registration status of these pesticides.

Comment Letter Number 23

From:

Kenneth W. Holt
Center for Environmental Health and Injury Control
Department of Health
Atlanta, GA 30333

Comment 23A: The FDA noted that they do not have access to the health and environmental safety data relied upon for the Environmental Protection Agency approval of the proposed pesticides, and therefore, have no way to confirm or contest the health and environmental risk assessments provided in the DEIS.

Response: All information used in the risk assessment that is based on registration data from EPA is available through the Freedom of Information Act.

Comment 23B:

The methodology used in the risk assessment is typical of the field, but it should be noted that these types of risk assessment have seldom, if ever, been validated through the collection of data.

Response: Although risk assessment is an inexact science, APHIS believes that it provides a useful tool for estimating, evaluating, and comparing the potential effects on health and the environment that may result from the alternatives. Risk assessment is an accepted practice in the scientific community.

Comment Letter Number 24

From:

Ronald H. Smith
Alabama Cooperative Extension Service
Auburn University
Auburn, AL 36849-5629

Comment 24A:

On page 4-38 (third paragraph) the document indicates that "Malathion has been proven effective and is approved for use at program application rates in the control of cotton aphids." Quite the contrary is currently true. Aphids have built to unprecedented numbers during the 1988 and 1989 seasons in fields that were receiving malathion sprays on a 5 to 7 day interval. Therefore, it may be concluded that malathion gives no control of aphids on cotton at this time.

Response: The discussion of program impacts on other cotton pests has been expanded in the final EIS.

Comment 24B:

Page 4-89: Your list for beet armyworm is incomplete. In fact, our most commonly used insecticide is not even listed. Thiodicarb and diflubenzuron are the current standards for beet armyworm control and should be added to your list.

Response: This list has been revised in response to your comment.

Comment 24C:

Reference to the Lloyd (1988) report cited on page 4-41, paragraph 1: Dr. Lloyd's conclusion differed from this entomologist drastically. I also examined this unusual beet armyworm outbreak and concluded, based on field scouting records from hundreds of fields from Lee, Elmore, Tallapoosa, and Macon counties during the months of June and July 1988 that the problem correlated almost identically to where the eradication program was ongoing. Dr. Lloyd's survey was conducted during the month of August, at which time the problem was occurring throughout the Southeast and Mid-South, both inside and outside the program area. His survey also included much data collected in west

Alabama, over 150 miles from where the most severe problems had been occurring for over six weeks prior to his appearance in the area. I would suggest that if Dr. Lloyd's reference is cited in the final draft, that other professional observations and conclusions also be included.

Response: The beet armyworm was a significant pest in cotton during the 1988 season. The armyworm pressure was especially intense in the Southeast. There are at least two reasons why this secondary pest became significant in 1988.

In early 1988 the Southeast experienced a severe drought. Historically, there is a strong correlation between dry weather and beet armyworm outbreaks. So early in 1988 the stage was already being set for a beet armyworm problem.

The second factor contributing to an armyworm outbreak was the application of pin-head square treatments in the spring. These early treatments with broad spectrum materials eliminate many naturally occurring beneficial insects. These insects can be effective in suppressing beet armyworm populations to manageable levels. Throughout the Southeast, varying amounts of pin-head square treatments are applied each spring. Where multiple treatments were applied in 1988, the beet armyworm often became a serious problem. This occurred in areas of the Southeast where the Boll Weevil Eradication Program was applying the spring treatments, but it also occurred in non-program areas where individual growers were applying similar treatments.

The Boll Weevil Eradication Program, therefore, did not cause the 1988 outbreak of beet armyworms. The problem resulted from a combination of very dry weather and the application of multiple pin-head square treatments that limited the effectiveness of beneficial insects. Wherever the boll weevil required early-season control, the beet armyworm became a problem, both inside and outside the program area. This only strengthens the argument for taking 2 or 3 years to eradicate the boll weevil, and then allowing growers to fully utilize beneficial insects in managing the remaining pest complex, including the beet armyworm.

Comment Letter Number 25

From:

Augustin Valido
U.S. Fish and Wildlife Service
75 Spring Street SW
Atlanta, GA 30303

Comment 25A:

Page 1-1, Paragraph 5: The draft document states that the boll weevil was directly responsible for a 2.24-percent reduction in cotton yield. If this reduction is occurring in concert with existing pesticide control techniques, it should be clarified what the percentage of estimated loss would be if chemical control measures were not used and what total percentage of lost production is occurring from all cotton pests.

Response: According to a communication with Dr. Bob Head at Mississippi State University (1991), cotton cannot be grown profitably without the use of pesticides. As discussed in chapter 1, total cotton losses from all cotton pests amount to about 6 percent of the cotton yield.

Comment 25B:

Page 1-15, Paragraph 1: The monitoring program initiated by APHIS for boll weevil control is of particular significance in assessing non-target impacts to wildlife. This section indicates that monitoring consists of sampling vegetation, flowing and impounded water, and fish in treatment areas. It is not indicated whether monitoring also includes post- and preapplication monitoring of bird population densities and species distribution. Monitoring should also include assessment of impacts of chemical alternatives on bird populations.

Response: Surveys to determine the density and distribution of bird populations are not planned for program personnel.

The chemical controls used by the program are also used in the program area, to varying degrees, by individual cotton growers and the general public. Even if extensive surveys were conducted on bird populations, it would be virtually impossible to determine the origin of any residues that may be detected.

Comment 25C:

Page 2-4, Paragraph 3: Are the participating States monitoring post-harvest stalk destruction? Or is this based on verbal commitment from the participating farmers?

Response: Responsibility for monitoring post-harvest stalk destruction varies with each program area. In some areas, State personnel monitor compliance. In other areas, Federal and program personnel monitor post-harvest stalk destruction. In all cases the State regulatory agency

is responsible for enforcing their regulations concerning stalk destruction.

Comment 25D:

Page 2-4, Paragraph 5: It appears that the use of trap crops would be extremely beneficial in the eradication program. We recommend that it be an integral part of the program. It should reduce the amount of pesticides used on the main crop.

Response: Trap cropping can be effective in areas where overwintering sites are limited. Individual growers within the eradication program may use trap cropping, but the program will not mandate its general use. As discussed in chapter 2 of the EIS, the practice lacks widespread acceptance among cotton growers and requires growing conditions which allow the economical production of short-season varieties of cotton.

Comment 25E:

Page 2-5, Paragraph 5: A new mechanical pest control method that is being utilized by some growers of commercial crops is the use of vacuum devices to pull insects off of plant parts. If adult boll weevils emerge from overwintering sites to feed on tips of cotton seedlings and cotton squares, this method may have relevance in cotton due to the uniformity of plant height.

Response: Vacuum devices are used in pest management on strawberries and lettuce and possibly other high-value crops.

The USDA's Agricultural Research Service tested vacuum devices on cotton in the late 1960s. Their research showed that there were at least two characteristics of the boll weevil that made the vacuum technology ineffective on cotton.

- The weevil is a heavy-bodied insect, and significant suction is required to remove it from the cotton plant.

- The weevil is usually concealed within the bracts of the squares, or buds, making extraction very difficult.

In addition, vacuum devices remove many of the beneficial insects which are often lighter and more frequent fliers.

APHIS is continually looking for new and effective methods for controlling the boll weevil. As these methods are developed they will be considered for inclusion in the program.

Comment 25F:

Page 2-6, Paragraph 2: We believe that intensified in-field trapping should be used extensively after the main program has been conducted.

Response: Program experience in eradicated areas over the past 8 years has demonstrated that a trapping density of one trap per 10 to 20 acres has effectively detected occasional reintroductions.

Comment 25G: Page 2-7, Paragraph 4: We recommend continued development and use of the sterile insect treatment methods.

Response: The use of sterile insects is one component of the integrated control approach developed for this program.

Comment 25H: Page 2-8, Paragraph 2: The draft document describes four chemicals considered for either aerial or ground application. These chemicals are malathion, azinphos-methyl, diflubenzuron, and methyl parathion. Three of the compounds are organophosphates. Diflubenzuron (dimilin) is a chlorinated diphenyl compound. The document indicates that these four compounds were the only alternatives available due to registration restrictions and economic factors. However, the use of synthetic pyrethroid compounds on cotton to control boll weevil is a registered use. Synthetic compounds appear to have a wide margin of safety to birds and mammals. Laboratory data indicate high toxicity to fish and aquatic invertebrates perhaps due to binding with organic material. Actual field mortality has not been reported. The EIS therefore should evaluate at least one synthetic pyrethroid compound.

Response: Of the many materials registered for boll weevil control on cotton, program management has determined that only the four materials referenced would be considered for use in the program.

Our response to comment 18C explains why we have not considered using a synthetic pyrethroid.

Comment 25I: Page 2-8, Paragraph 4: The use of only certified aerial applicators for this program is to be commended.

Response: Thank you for your comment.

Comment 25J: Page 2-9, Paragraph 2: We recommend, based on the toxicity of 3 of the 4 products used, that no aerial spraying be conducted when winds exceed 6 mph.

Response: Careful judgement must always be used during the aerial application of pesticides.

A variety of parameters are considered in making a decision regarding aircraft operation.

- The speed of the wind
- The nature of the wind, constant or intermittent
- The direction of the wind, consistent or swirling; head, tail, or crosswind
- The altitude of flight—treatment at 3 feet with 10 mph wind may be less prone to drift than one at 15 feet with 6 mph wind

- The location of any sensitive sites, their distance from the field, and their relationship to wind direction; upwind from the field
- The speed of the aircraft
- The orientation of the spray boom and its nozzles
- The presence of any windbreaks
- The material being used
- The time of day and any temperature inversion
- Population density and distribution
- The density of the crop canopy
- Presence of bees or other nontarget species

It is essential to remember that wind speed is only one of many parameters affecting the accuracy of an aerial application.

There is no substitute for good judgment, and the professional applicator must consider the total picture in determining when he should stop his control activities.

Comment 25K: Page 2-18, Paragraph 7: What is the toxicity of the aromatic petroleum distillates and other inert ingredients? Some petroleum products are extremely toxic.

Response: APHIS requested any information on inerts, including aromatic petroleum distillates, through the Freedom of Information Act with EPA. EPA responded that this information is confidential business information, and cannot be distributed.

Comment 25L: Page 2-21, Paragraph 4: We strongly recommend that APHIS increase funding for the study of biological control agents. The boll weevil is not going to be eradicated, but possibly reduced. The need for a control agent is going to be present as long as cotton is grown in the States.

Response: APHIS is currently involved in a variety of biological control activities on pests other than the boll weevil. Research has not yet identified agents that could be effectively integrated into a boll weevil control program. The current limitations on this method of controlling the boll weevil are described in chapter 2 of the EIS. APHIS continues to support efforts by ARS to identify effective biological control agents for use against the boll weevil.

Comment 25M: Pages 2-28 to 2-31: APHIS has identified the preferred alternative as "Eradication with Full Federal Involvement" to control the boll weevil.

The discussion of the management plan indicates that eradication may rely heavily upon a pesticide alternative to control boll weevils. In most instances, applications would be repeated from 6 to 8 times and possibly up to 25 times on some fields. Considering the broad spectrum toxicity of the preferred chemicals to non-target species, particularly beneficial insects and birds, the preferred alternative would appear to restrict future management options. If the other methods such as mechanical control and sterile releases are also used, the estimated proportion of each method to be utilized should be given.

Response: The program consists of a mix of control methods; the proportions of each to be used will be determined on a site-specific basis in response to local conditions. Initially, however, it is expected that most areas may require an initial emphasis on chemical control because it is the most effective method available at this time.

Comment 25N: Page 2-31, Paragraph 2: What is meant by the statement that "environmental components will be monitored." What components? How will the monitoring be conducted? By whom? Explain.

Response: This statement has been clarified in response to your comment.

Comment 25O: Page 2-31, Paragraph 4: The document indicates that boll weevil populations would be reduced to undetectable levels in an average of 2.5 years. An estimated 22 years would be required to fully implement the program in the remaining infested cotton belt states. The document does not discuss the means by which this proposed management plan (which appears to rely mainly upon pesticide application as the primary tool) differs from past methods and how it will achieve this reduction in 2.5 years. Pesticide applications have been utilized in the cotton belt since the advent of DDT with no apparent eradication of boll weevils. An explanation of how past control programs differ from the proposed management plan would be helpful.

Response: In response to these issues, discussions of the present status of the existing regional boll weevil eradication programs and the feasibility of the goal of eradication have been included in chapter 2 of the final EIS.

Comment 25P: Page 2-40, Pages 4-7 to 4-11: The document states that the control methods would not have a significant impact upon soil organisms although they could be temporarily affected by the chemicals. Malathion has a half-life in soil of 25 days (APHIS value), azinphos-methyl 12 days, diflubenzuron 3 to 7 days, and methyl parathion 5 days. If repeat applications occurred on a seven day interval, soil organisms would have little chance to recover.

Response: The soil half-life for malathion has been changed in the final EIS to 3 days. A discussion of the cumulative impact of the program

on soil microorganisms has been added to the final EIS in response to your comment.

Comment 25Q:

Page 2-40, Pages 4-13 to 4-16: The document concludes that the management program would not have a significant impact upon vegetation although it acknowledges that pollinating insects would be eliminated. In most instances, pollinators of common plants are not known. In locations where threatened and endangered plants occur, there is very little information available on pollinators. These data need to be gathered prior to a determination that this program will have no effect.

Response: All available information has been used in evaluating the impacts of the alternatives. Where information is uncertain or unavailable, this has been identified as a data gap in the EIS.

Comment 25R:

Page 4-18, Paragraph 5: The statement is made that the impact a pesticide has upon aquatic life is a function of six variables. A seventh variable, related to the toxicity of the compound and its degradates to exposed aquatic life should be added. In the last paragraph it is stated that the proposed chemicals will not enter rivers except by direct accidental spraying (or runoff). The effects of spray drift have not been discussed. In a similar section 7 consultation for the grasshopper control program, APHIS acknowledged that wind drift would occur with aerial application of pesticides.

Response: This discussion has been revised in response to your comment.

Comment 25S:

Pages 4-26 to 4-30: In addition to presenting acute oral LD_{50} data for mammals, birds, fish, and aquatic invertebrates, APHIS should present lethal dietary or exposure data for all species. On page 4-26, in the fifth paragraph, high doses should be defined in terms of active ingredients/ acre applied.

Response: All available information on the toxicity of these insecticides to nontarget species has been incorporated into the hazard analysis. As stated in the paragraph cited, the minimum application rate to produce cholinesterase inhibition in quail is not known, and further study is required.

Comment 25T:

Page 4-36, Malathion: APHIS concludes that reversible cholinesterase inhibition might be observed in some species exposed to malathion. Malathion is an organophosphate compound that has reversible inhibition of cholinesterase, however, this may take several days during which time repeated applications could cause additional cholinesterase inhibition.

Response: The discussion of cumulative impacts on nontarget species has been revised and expanded in the final EIS to address concerns such as this.

Comment 25U:

Page 4-36, Azinphos-methyl: We recommend that references be supplied for those instances where field studies are quoted that did or did not produce effects upon non-target organisms. This comment applies to all sections where acute and subacute effects of the chemicals are discussed. Azinphos-methyl applications that produce cholinesterase inhibition in avian and mammalian species cause adverse effects. Repeat applications would likely aggravate these effects depending on the interval between applications.

Response: This section has been revised in response to your comment.

Comment 25V:

Pages 4-26 to 4-27: The document does not provide 96-hour LC_{50} data for fish to evaluate the hazard of application rates in the control program nor are data for aquatic invertebrates provided. The study of Tapatz et al. that was cited as showing no effect on aquatic organisms in a mosquito control program should include the application rates of active ingredient applied.

Response: This section has been revised in response to your comment.

Comment 25W:

Page 4-27: The discussion regarding the acute and subacute toxicity of azinphos-methyl should indicate additional data on toxicity. We have included some values from Gregory J. Smith, 1987 "Pesticide Use and Toxicology in Relation to Wildlife: Organophosphorus and Carbamate Compounds" from U.S. DOI Fish and Wildlife Service Resource Publication 170.

Response: This section has been revised in response to your comment.

Comment 25X:

Page 4-37, Methyl parathion: Where chronic risks to wildlife are discussed for methyl parathion, it would be appropriate to identify the application rate in the control program. The application rates of methyl parathion in control programs that have caused acute adverse effects should also be listed.

Response: This section has been revised in response to your comment.

Comment 25Y:

Page B3-4, Paragraph 2: APHIS states that malathion is generally non-toxic to plants. The converse of this statement is that malathion is toxic to some plants on some occasions.

Response: This statement has been clarified in response to your comment.

Comment 25Z:

Page B3-8: The statement that azinphos-methyl is generally not toxic to plants is repeated again. APHIS should clarify whether azinphos-methyl is or is not phytotoxic to plants at the application rates in the control program.

Response: This statement has been clarified in response to your comment.

Comment 25AA:

Page B6-2: The table lists the diet items for representative species used to evaluate impacts to wildlife. Bird species are not listed as a diet item; however, they would be utilized by kestrels, fox, coyote, and snakes. A reference should be included in the table how the various diet items were determined. We recommend one potential source of information on dietary consumption in birds: E.E. Kenaga, 1973, Factors to be Considered in the Evaluation of the Toxicity of Pesticides to Birds in their Environment. In Environment Quality and Safety. Global Aspects of Chemistry, Toxicology and Technology as Applied to the Environment. Vol. II. Academic Press, Inc., New York, NY.

Response: References have been added to this section in response to your comment. Birds have been added as a diet item for snakes. For other species that consume both small mammals and birds, the entire diet was assumed to consist of small mammals for the purposes of the risk assessment because these would have a higher body burden of pesticide than would the birds. This provides for a conservative analysis.

Comment 25BB:

Table 2-1, Paragraph 2: Based on what happened in Georgia where many farm ponds were contaminated and fish killed, we recommend farm ponds be included in this paragraph and a buffer zone of 200 feet be established around all lakes and ponds.

Response: The program was accused of a number of fish kills when it expanded into Georgia in the fall of 1987. Most of the accusations centered around the use of azinphos-methyl and occurred during a time of year when most shallow farm ponds are oxygen deficient. However, several aerial applicators were reprimanded for unacceptable performance and additional training was provided for all applicators and program personnel prior to the 1988 season.

There has been a significant improvement in the quality of program treatment operations since 1987. Program personnel and applicators are more aware of the location of sensitive sites, and they have made appropriate adjustments in treatment procedures. In areas where cotton has been planted near lakes or ponds, additional emphasis has been placed on using ground equipment.

The results of the risk assessment in the EIS have not shown a need for buffer zones to be placed around bodies of water. This is in light of the operating procedures and mitigation procedures designed to protect these resources.

Comment 25CC:

We have tabulated LD_{50} and LC_{50} values for the four pesticides scheduled for use in the program (Table 1). It is evident from examining these data that the pesticides of choice should be malathion and diflubenzuron. There may be some price difference between the

chemicals, however, when human and environmental safety are involved, it would seem most prudent to utilize the safest chemicals available.

Response: Potential health impacts as well as economics will be considered when evaluating the insecticide to be used in a particular area.

Comment Letter Number 26

From:

Stephen A. Lewis
Oklahoma Department of Wildlife Conservation
1801 North Lincoln P.O. Box 53465
Oklahoma City, OK 73152

Comment 26A: The Oklahoma Department of Wildlife Conservation has reviewed the 1991 supplements to the 1989 DEIS that address Threatened and Endangered Species and Program Implementation in Alabama for the National Boll Weevil Program.

Based upon that review, we have no comments to submit at this time. We do request however, that our agency be involved in the preparation and review of any boll weevil plan for Oklahoma.

We appreciate the opportunity to review the supplemental documents for the National Boll Weevil Program.

Response: Thank you for your comment. APHIS will contact your agency prior to any boll weevil activities in Oklahoma.

Comment Letter Number 27

From:

Dell O. Clark
California Department of Food and Agriculture
1220 N. Street
P.O. Box 94281
Sacramento, CA 94271-0001

Comment 27A: Thank you for the opportunity to review the supplemental information you sent to the Department regarding the draft environmental impact statement for the National Boll Weevil Cooperative Control Program. Our comments refer to your Docket No. 91-111.

No specific comments are offered for the Alabama supplement. The supplement covering "Analysis and Protection of Endangered and Threatened Species" contains several corrections and modifications that are positive additions to the document.

Response: Thank you for your comment.

Comment Letter Number 28

From:

Larry D. McKinney
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744

Comment 28A

One of the safeguards of the plan is to modify treatment adjacent to known habitat of endangered species. However, it is not clear how endangered species habitat is known to occur. In counties where potentially affected endangered species are suspected to occur, toxic chemicals to control the boll weevil should be suspended until the absence of either endangered species or supporting habitat has been verified.

Response: Mapping of endangered and threatened species habitat will occur on a site-specific basis in consultation with local Fish and Wildlife Service personnel. At this time, protection measures as described in the biological assessment will be implemented, including potentially suspending the use of certain chemicals in the areas adjacent to endangered or threatened species habitat.

Comment 28B:

The list of endangered/threatened species for the south central region as contained in the APHIS DEIS 89-001 is not complete for Texas and raises the question of how species entries were determined.

Counties of possible occurrence of the Houston Toad (p. 4-17) are not complete. Additional counties of potential occurrence based on 1991 information include Austin, Fort Bend, Colorado, Liberty, Milam, Brazos, Freestone and Lavaca counties.

Response: Counties of Occurrence were determined through consultation with regional and local Fish and Wildlife Service Offices. Colorado, Liberty, Freestone, and Lavaca counties were not cotton-producing counties in the years 1985-1987. Austin, Fort Bend, Brazos, and Milam counties have been added to the "Counties of Occurrence" list in appendix H.

Comment 28C:

In regard to standard operating procedures for analysis of program impacts concerning the Texas blind salamander (p. 4-19), no information is provided concerning how the operating procedures are enforced. Please contact the Texas Natural Heritage Program, Texas Parks and Wildlife Department (512/448-4311) if additional information on listed species is needed.

Response: Standard operational procedures are a part of the contract established between program aerial applicators and APHIS.

Comment Letter Number 29

From:

Deborah Wassenaar
Southern Environmental Law Center
201 West Main Street, Suite 14
Charlotte, VA 22901-5064

Comment 29A:

The USDA fails to analyze objectively in the documents the feasibility of the program goal of eradication of the boll weevil.

Response: The discussion of opposing views in the EIS has been expanded to include more than just the single reference to "Cotton Boll Weevil: An Evaluation of USDA Programs."

Comment 29B:

The USDA makes the claim that eradication is an achievable goal, based merely on the alleged "success" of boll weevil control programs in other States. There is little evidence to support such claims, and the USDA fails to include in the document a fair and unbiased examination of the results of the program.

Response: Additional information on the success of the program in other States including southern Alabama has been added to chapter 2. The definition of eradication will be clarified.

Comment 29C:

The USDA states, for example, that it has been more than 5 years since the last boll weevil was trapped in Virginia. Virginia contains only about 17,000 acres of cotton, compared to Alabama's average of 179,103 acres between 1985 and 1988. The acclaimed "success" of the eradication program in Virginia does not serve as an adequate indication that eradication can occur in a state like Alabama with over ten times the amount of cotton acreage and with differing climatic and other conditions.

Response: Program results in Alabama have been added to chapter 1 in response to your comment. APHIS feels that the program in Virginia has been very successful, and that results to date indicate that the Alabama program will be just as successful.

Comment 29D:

In addition, although the USDA claims that the program will only last approximately three and one-half years, the program has been ongoing in North Carolina since 1977 and there is no claim that the boll weevil has been eradicated there. Thus the agency cannot fairly point to North Carolina to bolster its claim that eradication is feasible within three and one-half years or at all. Similarly, reliance on the "success" of the program in the southwest (California, Mexico, and Arizona) also appears to be misplaced. Boll weevils are still found in these areas (more than three and one-half years since initiation of the program), and these areas greatly differ from Alabama in climate and other respects, and likely serve as a poor comparison model.

Response: The EIS discussions have been expanded to offer two situations in which the program might extend beyond 3½ years. The status of North Carolina has also been clarified. The program expanded from the pilot test area to include all of North Carolina in the fall of 1983. Three years later, in 1986, the State was declared boll weevil free.

Comment 29E:

Equally telling is the failure of the USDA to discuss anywhere in the document the results of the program in the 21 southern Alabama counties. As stated above, the 1991 Alabama Supplement is grounded on the assumption that eradication of the boll weevil will occur in three and one-half years in each program area. The eradication program was begun in the 21 southern Alabama counties in the fall of 1987, more than three and one-half years ago. Boll weevils still exist in southern Alabama, however, and the USDA's failure to acknowledge this fact in the document and reexamine the objectives of the program in the light of the evidence undermines the entire premise of the EIS.

Response: Results of the program in Alabama have been included in the chapter 1. Alabama counties next to Florida are very close to being eradicated; those next to central Alabama counties, which are not yet in the program, are being treated as a buffer area.

The final EIS will also add information about the reasons why the program in the current increment is taking longer than expected. There were problems with azinphos-methyl in 1987. This coupled with the unusually high number of boll weevils beltwide in 1988 when the budget did not allow for the number of treatments needed to control the high infestation.

Comment 29F:

The agency's rigid refusal to examine objectively the feasibility of eradication also leads the agency to gloss over other concerns. For example, the USDA acknowledges the possibility of insecticide resistance by the boll weevil and other cotton pests as a potential consequences of the program. It acknowledges that the broad scale use of pesticides, as opposed to more isolated treatments now being done by growers, would subject the pest species to greater pressure to develop resistance. In addition, the agency acknowledges that repeated applications of the program chemicals could cause the elimination of beneficial

insects and contribute to the population growth of secondary pest species. The agency dismisses these serious concerns, however, on the unfounded assumption that the program is expected to be completed within three and one-half years.

Response: APHIS feels that the risk of insecticide resistance and destruction of beneficial insects during the first year or two of the program is secondary compared to the risks that could result from long-term suppression.

Comment 29G:

Moreover, the agency has not critically examined its assumption that pesticide use, as a result of the program, will ultimately decrease. Some scientists have noted that with the intensive use of pesticides, in fact the opposite is true. Since 1945 when pesticide use began, there has been a 20 fold increase in both the amount and toxicity of insecticides used, while crop yields lost to insects have actually doubled.

Response: Actual experience in North and South Carolina indicate total control costs declined 39 to 71 percent, indicating a comparable decrease in the amount of pesticide used after eradication.

Comment 29H:

In addition, the USDA claims that cotton producers in the Cotton Belt have been able to reduce their total pesticide use by 50 to 90%. The USDA does not examine whether the alleged reduction in pesticides used is fairly attributable to the boll weevil control program or whether the claimed reduction is attributable to reasons outside the program, such as changes by the growers themselves in the type of pesticides used for other cotton pests, and the rates of application (or pounds/acre) used. For example, the growers have switched to pyrethroids to control Heliothis, using a much lower rate of application than other pesticides, which may in part explain the alleged reduction in total pesticide use.

Response: The EIS is including more information from Gerald Carlson's paper on the economic benefits of boll weevil eradication. This information includes data on the amount of pesticide used before and after the program, allowing a more accurate prediction of the reduction in the use of peticides.

Comment 29I:

The Stipulation of Settlement specifically requires the USDA to "identify and discuss scientific information that exists that is contrary to any assumptions, conclusions or objectives set forth in the USDA." The agency has disregarded this requirement entirely. The USDA merely acknowledges that "there are cotton producers and members of the scientific community who question the feasibility of eradication," and that "it is possible that the program could fail." The USDA completely fails to include <u>any</u> discussion in the document of the scientific information that exists that deems eradication to be infeasible.

This omission is inexcusable. The conclusion is inescapable that the whole process has been warped by the agency's unwarranted bias in

favor of eradication. One commenter has observed that, from the beginning, a certain group at USDA has dominated agency policy and has doggedly pursued eradication as a goal, excluding open debate and evaluation of the feasibility of this objective. Unfortunately, little has changed.

Response: A new section on scientific opinion contrary to the premise of eradication has been added to chapter 2 in response to your comment.

Comment 29J:

Our comments on the 1989 draft EIS pointed out that the 1989 Draft EIS fails to satisfy the requirements of paragraph 1 (c) of the stipulation of settlement and those comments equally apply here. The USDA predicts that eradication will occur and that the proposed program will last an estimated three and one-half years in each area. The USDA fails to discuss that inconsistency of that projected duration with the fact the program in south Alabama has been going on since 1987 and in other parts of the Southeast since at least 1977. As stated above, the lack of objective analysis is tied to the unexamined assumption that eradication is feasible.

Response: Additional information on scenarios where the program may last longer that 3½ years has been included in chapter 2, along with information on the unusual problems that occurred in southern Alabama. However, APHIS feels that on average, the program will last 3½ years in each increment.

Comment 29K:

In addition, the agency merely refers to the proposed expansion of the program into the remainder of Alabama, but does not give an estimate of when this would occur or when the grower referendums would take place, in violation of the Stipulation of Settlement.

Response: The updated version of table 4-9 in chapter 4 provided a projected timeline for program expansion. Expansion cannot be realistically predicted more than 2 years ahead.

Comment 29L:

As we stated in our comments on the 1989 draft EIS, under NEPA regulations, the discussion of alternatives "is the heart of the EIS." The agency claims that the feasibility of the IPM approach is examined in the supplement and the other alternatives are not evaluated because the draft EIS contains a full discussion of those alternatives.

We rely on our comment on the draft EIS that the USDA in fact failed in the draft EIS to consider a full range of alternatives and to evaluate objectively the alternatives presented. Only one of the stipulated-to alternatives was even mentioned in the EIS -- direct subsidy to growers -- and the agency dismissed this alternative without adequate discussion. Thus the draft EIS in no way can be taken to provide a discussion of the full range of alternatives as required by NEPA and the Stipulation of Settlement. Nor has the agency remedied this fatal defect in the 1991 Alabama supplement because the USDA refers to

(and dismissed as infeasible) only one additional alternative -- the integrated pest management approach (IPM).

Response: The analysis and discussion of the alternatives has been expanded in chapter 2. The reasons why alternatives were deemed infeasible have been clarified in this section as well.

Comment 29M:

Before turning to the treatment of IPM in the USDA 1991, we would emphasize that, in revising the EIS to include a full range of alternatives, the Stipulation of Settlement specifically requires the agency to include as an alternative different methods of applying any pesticides, including the use of ground equipment as opposed to aerial application, and the use of high volume aerial spray as opposed to ultra low volume spray. Scientists have found that, if ultra low volume spray is used, at least 75% of the pesticides will fail to reach the target area because of pesticide drift.

Response: High volume aerial spraying was looked at, and judged to be inferior to ULV application. This discussion can be found in chapter 2. The use of ground equipment has been considered, and it has been calculated that ground equipment may be used on approximately 5 percent of all fields.

Comment 29N:

Further, scientists have estimated that approximately 40% of the insecticides currently used on cotton could be reduced through the use of readily available non-chemical alternatives and changes in equipment, including avoidance of ultra low volume spray. While the USDA acknowledges in the 1991 Alabama document that ultra low volume spray presents problems of increased pesticide drift, the agency eliminates the use of high volume spray on the ground of economic infeasibility, and dismisses the problem of increased drift as inconsequential. This discussion does not satisfy the need to consider fully the range of alternatives.

Response: The final EIS will acknowledge the increased potential for drift from ULV applications. Extensive operational procedures and mitigation measures will decrease adverse effects from this drift.

Comment 29O:

In the Alabama comments, the agency dismisses IPM as a possible alternative, claiming a true IPM approach is infeasible in Alabama, given the relatively warm winters, abundance of over-wintering sites, and the lack of effective biological controls for the boll weevil. Such conclusory assertion fails to satisfy the requirement that alternatives be fully and thoroughly discussed. For example, the agency has failed to acknowledge, let alone discuss, scientific opinion to the contrary that IPM is a valid and effective means to control the boll weevil.

Again the agency's failure to examine the IPM approach shows an unwarranted bias in favor of eradication. IPM seeks to reduce boll weevils and other insect pest populations to subeconomic levels, by a variety of controls, including the use of beneficial insects. Insecticides

(and the least toxic insecticides) are used only on a limited basis and as a last resort. By contrast, eradication seeks to eliminate the insect species entirely, through massive and intensive use of pesticides. In addition, IPM looks at the whole pest problem in crafting a pest control strategy, and requires an analysis of the pest problem and control methods on a site specific basis. By contrast, the agency's alternative -- eradication – is necessarily premised on a monolithic approach: all cotton acreage is subjected to pesticide spraying, regardless of site-specific differences.

Response: APHIS recognizes that various opinions exist regarding IPM. The commenter's statement that all cotton acreage is subjected to pesticide spraying, regardless of site-specific differences, is incorrect. Only infested fields are treated, and treatment methods are determined by weevil density, proximity to sensitive areas, and other considerations. Each field is considered on a site-specific basis.

Comment 29P:

The USDA gives a summary of economic costs of the program but fails to consider the extent and costs of the program beyond the three and one-half years projected duration of the program. This failure is significant, given, as stated above, the fact that the program has already extended well beyond this time frame in each state. The USDA cryptically states in the document that, after eradication, the nonfederal share of program costs would likely be reduced to less than $10 per acre, but gives no information on the purpose of this cost or how long such costs could be expected to continue.

Response: The 3½ year projected duration is the average expected length of the active eradication phase of the program. The nonFederal share of program costs ($10) after eradication is the costs of the confirmation and post-eradication phases of the program (see chapter 2).

Comment 29Q:

In addition, for a true evaluation of the costs of the program, the agency should also consider in the document the indirect costs of intensive use of pesticides under the program, such as destruction of the natural enemies of other cotton pests and development of pesticide resistance; poisoning of domestic animals, wildlife and aquatic life; killing of honey bees; damage to crops and forest resources; and the costs for monitoring wells and groundwater contamination.

Response: Calculating indirect costs would be a massive undertaking. In general, indirect costs for the no action alternative may be higher than for the other alternatives in the long run. Indirect costs for the eradication alternative are likely to be high in the short-term; however, with the decreased pesticide loading to the environment that has resulted from eradication, the long-term costs will decrease.

Comment 29R:

Moreover, the comparison of the costs of the program with the grower's current costs is confusing and potentially misleading, The USDA indicates that the nonfederal share of the projected costs of expanding the program in Alabama would be less than $25 per acre.

Twenty-five dollars per acre, however, is not the actual nonfederal cost, but rather appears to the projected incremental cost over what the grower already pays. In addition, the projected incremental costs to central Alabama growers appears to be even more than $25 per acre. The USDA should explain these projected costs more clearly in the final EIS.

Response: The cost per acre figures have been clarified to show the difference between the pre-program costs and costs during the eradication effort. Aside from their assessment, growers pay nothing to control boll weevils during and after eradication.

Comment 29S: The USDA must include in the document an analysis of the economic costs of all reasonable alternatives to the program, as required by the Stipulation of Settlement. Not surprisingly, because the agency fails to address alternatives in the document, it also fails to include costs of any alternatives.

Response: Appendix E reveals the projected costs of each control method and each program alternative. The no action alternative can be assumed to cost approximately the same as the suppression alternative. No further costs estimates are planned.

Comment 29T: The USDA includes in the 1991 documents an assessment of the topographical, geographical features, and soil conditions in Alabama, but it does not give a detailed assessment of other conditions specific to Alabama, including the size of cotton fields and their proximity to bodies of water, buildings, recreational areas, and habitat of threatened and endangered species. Because the USDA does not discuss any alternatives in the document, it also fails to analyze the potential environmental consequences of any alternatives. Further, as discussed below, the USDA gives an inadequate assessment in the documents of the environmental consequences of the chosen alternative, and it glosses over the risks that will be present.

Response: APHIS believes that the EIS and appendix I have enough information to develop protective measures for all areas in Alabama and no further work on this issue is required.

Comment 29U: The USDA failed in the Draft EIS and has failed in the 1991 supplements to analyze and compare conditions in Alabama to any area where the program has been deemed by program officials to be successful, in violation of the Stipulation of Settlement. As stated above, the USDA has merely alleged in a conclusory fashion that the program goal of eradication has been successful in other areas, such as Virginia, North and South Carolina, and the Southwest, without examining the conditions under which the program has been "successful" or adequately accounting for the continued infestation of boll weevils. Variations in climate can dramatically affect the magnitude of the pest problems; moreover, the documents show that Virginia contains only a fraction of the cotton acreage that Alabama has. The USDA has not attempted to

analyze whether these and other differences make it likely that program methods that were deemed "successful" in other areas (despite the continued presence of boll weevils) would be successful in Alabama where the boll weevil problem is more extensive.

Response: Information on the results of the program in southern Alabama has been added to chapter 1.

Comment 29V:

The Stipulation of Settlement requires the USDA to address potential environmental consequences from the alternatives proposed, including, but not limited to, certain potential risks specified in the Stipulation of Settlement, and to analyze the potential risks of each pesticide proposed. The requirement to include a thorough and fair discussion of potential environmental impacts is also firmly rooted in the NEPA regulations. As we pointed out in our comments on the 1989 draft EIS, the USDA does not discuss adequately in the 1989 draft EIS the potential environmental effects from the proposed action. The 1991 supplements fail to correct these serious inadequacies. The USDA consistently either understates the risks or attempts to explain these risks away, relying on the proposed mitigation proposals, which are themselves inadequate. The USDA also fails to account in any serious way in the documents for the scientific uncertainty that surrounds the intensive and persistent use of highly toxic chemicals over a vast area.

Response: APHIS feels that the analysis of risks is sufficient. Additional information on the operational procedures and mitigation measures has been added to chapter 2.

Comment 29W:

We rely on our Comments on the 1989 draft EIS on the issue of pesticide drift. The USDA, in the 1991 documents, again glosses over the problem of pesticide drift, stating that the mitigation proposals will alleviate this concern. The reliance on mitigation measures is not a substitute for a thorough discussion of the risk and consequences of drift; moreover, as discussed below, reliance on the proposed mitigation measures is misplaced.

Response: APHIS feels that there is a significant difference between detectable levels of drift offsite and environmental contamination from drift offsite. Although the conditions were different from those of the proposed program, field validations have been done for the AGDISP drift model. The modeling shows deposition decreases rapidly beyond 50 feet from the edge of the field. APHIS believes that the mitigation measures and operational procedures proposed will reduce potential risks significantly.

Comment 29X:

In addition, the USDA fails to impose any buffer zones (apparently with the exception of a limited buffer zone if methyl parathion is used, as referred to in the 1989 draft EIS). There is no discussion in the documents of the potential for drift in the absence of buffer zones or any analysis of why buffer zones are not included.

Response: Programmatic designed buffers are likely to hinder the accomplishment of the program goal of eradication. In many instances, ground equipment will be used adjacent to sensitive areas in lieu of buffers.

Additionally, APHIS will comply with State-mandated buffers (see chapter 5) and will discourage growers from planting cotton in areas that cannot be treated. APHIS believes that site-specific attention to local areas of concern will be more effective in reducing risks than beltwide prohibitions.

Comment 29Y:

The failure to provide buffer zones or examine the potential for drift in the absence of buffer zones is an especially serious concern because many cotton fields in Alabama are located in close proximity to farm ponds, residences, and wooded areas. Beginning with the fall 1987 spraying, there have been numerous cases of pesticide drift and spraying of non-targeted areas, resulting in a haze of chemicals moving over non-targeted fields, pastures, buildings, humans, and animals. The USDA's failure to consider alternatives that would reduce the potential for drift, and its failure to thoroughly examine the risks and consequences of drift, violate the Stipulation of Settlement and the NEPA regulations.

Response: APHIS acknowledges the potential for significant impacts from near-field (within 50 feet of the field) drift. There is likely to be some risk to nontarget species, especially aquatic species in small streams or ponds near cotton fields. See the response to comment 29X for additional information.

Comment 29Z:

We reiterate our concerns stated in the Comments on the draft EIS that the USDA failed in the draft EIS adequately to account for the serious potential effects from the pesticide spraying program on non-target organisms. The USDA has not cured this inadequacy in the 1991 documents. The discussion of effects both in the draft 1989 EIS and the 1991 Supplements reveal that there are numerous and very significant risks, under the preferred alternative, to a wide range of non-target species. The USDA glosses over many of these risks in the Supplements, again relying on the unfounded assumption that the program will be completed within approximately three and one-half years, and concluding that the adverse environmental consequences will be short-lived. Here too, the agency's rigid refusal to even consider that the program will not achieve its goal of eradication completely warps the analysis of environmental effects.

Response: Data on the program in southern Alabama has been added to chapter 1, indicating that eradication is feasible and nearly accomplished in some counties. APHIS believes that the risks of the eradication program, although potentially significant in the short-term, are outweighed by the significant environmental benefits from the substantial reduction in pesticide use.

Comment 29AA:

In addition, the USDA understates the risks in many instances in the 1991 documents. For example, while the USDA acknowledges that repeated applications of malathion and methyl parathion may eliminate beneficial insects and contribute to the population growth of secondary pest species, the agency attempts to minimize this effect by claiming that beneficial insects will reestablish themselves once the boll weevil is eradicated. The USDA fails to consider the long-term effects and costs of the elimination of beneficial insects if the assumption that eradication is achievable is incorrect.

Response: The results in Virginia and North and South Carolina attest to the capability of beneficial insects to return to the cotton fields, and to the lack of long-term effects. Evidences of this include decreased pesticide costs for cotton pests other than boll weevils, and the presence of honey bee hives in some eradicated cotton fields. APHIS maintains that effects on beneficial insects will be short-term.

Comment 29BB:

Similarly, the USDA also understates the risk to aquatic organisms. The USDA acknowledges that insecticides could have an overall pesticide burden that could put local streams, rivers, and farm ponds at risk, particularly in the late summer months when waterways are more stressed. But, elsewhere in the document, the agency dismisses these concerns, stating that dilution will be sufficient in many cases to reduce insecticide concentrations to safe levels.

Response: APHIS acknowledges that some streams and ponds near treatment areas may be adversely affected by the program chemicals. However, most of the risks stem from chemical contaminated run-off, which can be minimized by mitigation measures and operational procedures, such as not spraying when rainfall is predicted.

Comment 29CC:

Dilution is not an acceptable solution to pesticide contamination. What is left unsaid and unexamined is that this means that there will be a dead zone at the point of discharge where non-target organisms will be significantly at risk.

Response: Runoff is not a point source of contamination. Few fields are likely to have channelized runoff running directly into a river or stream. The time it would take for pesticide-laden runoff to enter a stream and dilute to acceptable concentrations is, in most instances, a matter of seconds.

Comment 29DD:

The USDA also acknowledges that diflubenzuron is highly toxic to aquatic invertebrates; that malathion also poses a significant risk to aquatic communities because it is highly toxic to certain fish species; and that methyl parathion is also highly toxic to aquatic invertebrates, but less toxic to fish and amphibians than malathion. The suggestion in the document that methyl parathion could be used in locations where fish or amphibian species require protection, is no answer to the fact that methyl parathion is also highly toxic to aquatic invertebrates, and

that its use may also have an indirect impact on other aquatic species through the food chain effect.

Response: Indirect effects were looked at in the nontarget species risk assessment. Methyl parathion would have an adverse effect on aquatic invertebrates and would be used as a mitigation measure only for sensitive (proposed, endangered, or threatened) aquatic species. In these instances, the species of concern's diet would be examined once again to assess the potential for indirect effects from methyl parathion.

Comment 29EE:

The agency also acknowledges that wildlife or aquatic species may be exposed and that some individuals may be affected or die, but rationalizes this risk by stating that no significant population effects are expected. Such superficial assessment is not a substitute for a full and objective examination of the risks.

Response: APHIS believes that the nontarget species risk assessment for the proposed program is a full and objective examination of risks.

Comment 29FF:

Dr. Jeffrey Foran, an expert witness in our law suit, analyzed the quantity of pesticides used during 1987 and the projected estimates for 1988. Dr. Foran testified that at least 1.6 million pounds of azinphos-methyl were applied in four states during the 1987 fall program and at least 100,000 pounds of azinphos-methyl were applied in the fall of 1987 over the 65,000 acres of cotton in southern Alabama involved in the program. Dr. Foran testified that the quantity of pesticides proposed to be applied during the program and the proposed method (primarily by aircraft) presented a substantial threat to non-target organisms, off-site habitats, and to human health in and near application areas. The USDA completely fails to analyze in the documents the impacts associated with the vast quantity of pesticides and acreage involved.

Response: APHIS believes that Dr. Foran's data of 1.6 million pounds is closer to 800,000 pounds. Azinphos-methyl was used in three states, not four in 1987. Pesticides applied during the program decrease over the life of the program. The program does not increase pesticide application rates over what farmers would ordinarily be applying themselves.

Comment 29GG:

The 1991 Endangered and Threatened Species Supplement indicates that there are approximately 198 endangered or threatened species in the cotton producing counties, of which 85 may be adversely affected. by insecticide exposure. The USDA concludes in the document that the species will be protected from "unacceptable" risks by various protection measures. The USDA indicates that, for terrestrial species, these measures may involve buffers of 200 or 300 feet in which aerial application would be prohibited, and for aquatic species, buffers and monitoring of weather conditions.

The proposed measures are only sketchily described, and as such do not give assurance that endangered or threatened species will be protected. Moreover, for certain species, buffers will not suffice. For example, Dr. Jeffrey Foran, in pointing out the threats to endangered species as a result of the program, testified that bald eagles, ospreys, and other fish-eating birds may be at substantial risk. According to Dr. Foran's expert testimony, direct exposure may occur as a result of off-site drift, and this exposure may only be prevented where a comprehensive nesting and individual mapping program is conducted immediately before any spray activities. Simple consultation with wildlife agencies before spray activities would not identify locations of new nests or individuals when mapping results are more than several months old. Further, according to Dr. Foran's testimony, exposure may occur indirectly through consumption of prey contaminated by pesticides.

Response: APHIS has prepared the programmatic Biological Assessment that sufficiently details for each species the protection measures to be used. This biological assesment was submitted to Fish and Wildlife Service in December 1990 with a request for formal consultation. Although work continues between APHIS and FWS, no further work is planned for the final EIS to address this issue. In addition, depletion of prey base and consumption of contaminated diet items are included in the endangered and threatened species risk assessment (see appendix H).

Comment 29HH:

The 1991 Endangered and Threatened Species Supplement also fails to include a full listing of the threatened and endangered species that occur in the program area and could be affected by the pesticide spraying program. We note the following errors and omissions:

- The gopher tortoise is listed as occurring only in Alabama; it also occurs in Mississippi;
- The yellow-blotched sawback turtle is a threatened species that occurs in Mississippi, but it is omitted from the document;
- Both the goldline darter and the blue shiner occur in Alabama and are proposed for federal listing as threatened species; neither is included in the document;
- The following endangered mussel species are native to Alabama and are found in cotton growing areas in Alabama, but are not indicated as such in the document: *Obovaria retusa, Conradilla caelata, Hemistena lata, Plethobasus cicatricosus, and Epioblasma f. florentina.*

Response: Counties of Occurence information for the gopher tortoise and the five mussel species mentioned were given to APHIS by FWS. This data was determined in consultation with regional and local FWS offices.

In order to complete the ESA section 7 consultation in a timely manner, FWS and APHIS agreed to a cut-off date of April 1991 for those species and habitats to be included. No further work is being planned for the current Biological Assessment. However, future consultation will be required to take into account new listings and new cotton-producing counties.

Comment 29II:

In addition, the USDA erroneously concludes that the red hills salamander will not be affected by the pesticide spraying program. Some cotton fields are close enough to the habitat of the red hills salamander, however, for drift to impact the animals either directly or indirectly through effects on its food supply (forest-floor arthropods). More generally, the document also fails to identify location of habitats of endangered or threatened species in proximity to cotton fields, as required by the Stipulation of Settlement.

Response: The habitat of the Red Hills salamander, according to FWS personnel, is not located near cotton fields. APHIS understands that SELC may disagree with the analysis of program effects. It is virtually impossible to provide the proximity of species habitats in relation to cotton fields throughout the Cotton Belt. Many plant species habitats are as yet undefined.

Comment 29JJ:

The USDA acknowledges in the document that other pesticides are used on non-cotton crops, but states that these pesticides have a "remote chance of synergistic effects with program insecticides. The USDA fails to provide adequate information to determine whether synergistic effects are in fact "remote." It gives no analysis of the types of chemicals used on non-cotton crops or the possible interaction of pesticides used to control other cotton pests.

Response: Additional information has been added to the section on synergism (see chapter 4 and appendix B, section B2). The discussion of potential cumulative effects of program activities with non-Federal activities has been expanded to include effects with other pesticides. It is nearly impossible to assess potential impacts of the chemicals used on crops other than cotton, as these are numerous and vary throughout the Cotton Belt.

Comment 29KK:

The USDA also fails to take into account in the document information to the contrary. Dr. Jeffrey A. Foran testified in the lawsuit, for example, that nontarget organisms likely will suffer the impacts of joint toxicity. Several factors contribute to this risk, including the potentiation of the program pesticides by other toxicants, the fact that large quantities of other pesticides are likely used in or near the eradication zone, the large scale application of the pesticide program in the Southeastern United States and in Alabama, and the multiple routes of potential exposure. The USDA should revise the documents to address these concerns.

Response: The Cumulative Effects section in chapter 4 has been expanded to include some of these concerns. However, it is not possible to address this in any specific manner.

Comment 29LL:

The agency also proffers two weak assertions to justify its lack of analysis of potential joint action/joint effects: first, that the program has no control over pesticides used on nonprogram fields, and second, that compliance with label restrictions should alleviate the problem. The latter makes no sense because label restrictions will not take into account pesticides used on other crops. Further, the claim of lack of control over pesticide use on non-program fields does not relieve the USDA of the responsibility to analyze the potential for joint actions/joint effects from other pesticides used on cotton and other crops.

Response: See the response to comment 29KK.

Comment 29MM:

We reiterate our Comments on the 1989 draft EIS concerning the inadequacies in the analysis of the potential for groundwater contamination.

The USDA fails adequately to analyze in the 1991 Alabama Supplement the potential risk of groundwater contamination. The USDA acknowledges in the document that the use of malathion has the potential to contaminate groundwater, but dismisses this risk, stating that, based on the modelling output, none of the insecticides should reach the groundwater in any "significant" amount. The USDA does not offer any analysis to allow the reader to judge whether such serious risk can be so lightly disregarded. The agency also relates that the Alabama Department of Environmental Management (ADEM) is conducting a groundwater monitoring study to develop a protection strategy for pesticide application in Alabama, and that, of 150 well samples taken in 1989, only one sample contained any detectable concentration of malathion. No information is given, however, whether the wells that were sampled were located near cotton fields that had been treated with malathion.

By contrast, Dr. Jeffrey A. Foran testified that the use of malathion in the boll weevil pesticide spraying program involved the significant risk of groundwater contamination. Dr. Foran concluded that, under selected conditions, including application of malathion on or near sandy loam soils, which are relatively common in Alabama, malathion can reach groundwater and persist for relatively long periods of time. In addition, Dr. Foran pointed out that Alabama is rated as high to very high for groundwater pollution potential under the system developed by the National Water Well Association for determining groundwater pollution potential.

Response: APHIS believes that the risk assessment is sufficient to address this concern. Also, if Alabama has a high potential for groundwater contamination, it is very significant that only 1 well out of 150 showed any malathion residue. Malathion has a wide variety of agricultural uses outside of cotton pest control.

Comment 29NN: The USDA also glosses over the potential for contamination of surface water. For example, many of the state's largest reservoirs are located in the Tennessee River drainage in north Alabama. The agency only briefly discusses the risk in the Alabama Supplement that the pesticide spraying could contaminate these municipal drinking water sources; this risk deserves greater consideration. It is also a significant concern that the state environmental agency, ADEM, does not perform surface water pesticide sampling. Thus, it is uncertain whether contamination of surface water would even be adequately monitored.

Response: The EXAMS II modeling addresses the risk of surface water contamination in the Tennessee and Alabama Rivers. The modeling indicates that there is no risk to the public from program applications. Very large bodies of water, such as drinking water sources, are not likely to achieve pesticide levels sufficient to adversely affect human health.

Comment 29OO: The U.S. Environmental Protection Agency has identified significant data gaps for malathion, methyl parathion and diflubenzuron. The USDA does not address these uncertainties in the documents. In addition, the agency acknowledges that, in assessing the potential toxicity of the pesticides to aquatic and terrestrial species, it lacks toxicity data for many species and has relied on toxicity data for other known species. The agency does not give adequate information, however, to ascertain whether these toxicity surrogates are valid; nor does it consider the possibility that the risk may be seriously understated for certain species if the organisms are not sufficiently similar.

Response: APHIS acknowledges that data gaps and uncertainties exist for some of the proposed chemicals. This issue has been addressed in the final EIS (see chapter 4). The use of toxicity surrogates is accepted by EPA and the scientific community. Although different species may have different reactions to a given chemical, APHIS strives to use the most conservative estimation of toxicity possible for a given species thus reducing the potential of understating risks.

Comment 29PP: The USDA gives a general explanation of the structure and management of the program, but it fails to provide adequate information concerning the sources of funding for the program. The USDA also should carefully examine and disclose the possibilities of lack of state funding, or other circumstances that would create a shortfall and affect the cost of the program, and the ultimate impact of such cost increases on the participating farmers.

Response: Information on how the program costs are shared has been expanded in the final EIS. Growers could be responsible for up to 70 percent of the cost if their State does not contribute. However, so far, Arizona, California, Alabama, Georgia, Florida, North Carolina, and Virginia all have shared program costs with growers, and APHIS has provided the remaining 30 percent.

Comment 29QQ:

Both the draft 1989 EIS and the 1991 Supplements are devoid of any discussion of the Alabama program results. As stated above, the USDA must include in the documents an analysis of the results of the program, including whether the boll weevil in fact has been eliminated in south Alabama (which it has not), whether the timetable of three and one-half years to eradicate the boll weevil is realistic (which it has been shown not to be), and whether the cost and results of the program are as predicted. An adequate evaluation of the success or failure of this program in south Alabama is critical in assessing whether to implement the program in the remaining regions of Alabama. An indispensable element in this analysis is an actual accounting of the current boll weevil populations in south Alabama and a comparison to predicted reductions.

Response: The discussion of the results in the southern Alabama counties has been included in the final EIS (see chapter 2).

Comment 29RR:

In the Alabama Supplement, the USDA summarizes, but does not analyze, the complaints received by program staff from 1987 to 1990 and their responses. The USDA merely groups the complaints in broad categories, and provides no discussion. The USDA refers the reader to the 1988 Spring-Summer Boll Weevil Suppression Program Environmental Assessment for a more complete analysis of the complaints. This reference does not cure the defect in the 1991 Supplement, however. First, the 1988 document did not contain a complete analysis of the complaints received. Second, the agency's obligation under the Stipulation of Settlement is to analyze all complaints received to date, and the Environmental Assessment was prepared in 1988.

Response: The discussion of the corrective action taken in response to the complaints has been expanded in appendix I.

Comment 29SS:

Nevertheless, the cursory summation of the complaints in the 1991 document reveals serious problems, ranging from fish kills, human illness, pesticide drift, animal or livestock illness, bee kills, spraying outside the target area, as well as inadequate control of boll weevil damage. The USDA acknowledges in the 1991 Alabama document that many of these complaints appear to be valid after investigation, but the USDA fails to include an analysis of why such problems have occurred. (We would also point out that the complaint that the boll weevil has been inadequately controlled is relevant to the issue of the effectiveness of the program in south Alabama, but the USDA completely fails to analyze program results in south Alabama in violation of paragraph 1(1) of the Stipulation of Settlement.)

Response: APHIS acknowledges that, as with any new endeavor, the initial period of the program in Alabama had some difficulties. However, as the program continued, changes were made to enhance program operation and resolve the problems.

Comment 29TT: Further, the Stipulation of Settlement requires a detailed analysis of any changes in the program designed to avoid such complaints. There is no such detailed analysis. Rather, the USDA briefly indicates in the document that program procedures were modified to minimize the risk of future occurrences, citing improved pilot education, adjustment of spraying equipment, reduction of spray height, notification of potentially affected parties in advance, and elimination of the use of azinphos-methyl in Alabama.

The document, however, fails to support the statement that any changes have occurred other than the choice to eliminate the use of azinphos-methyl in Alabama. The USDA still proposes in the document to use ultra-low volume air craft, with a high risk of pesticide drift. And, in some respects, the USDA proposes to relax program practices by, for example, increasing the allowable height for aerial application of pesticides from that agreed to in the Stipulation. Moreover, although the agency has proposed to eliminate the use of azinphos-methyl, it is proposing to substitute a more acutely toxic organophosphate, methyl parathion. The substitution of methyl parathion for azinphosmethyl is hardly an adequate means of addressing concerns.

Thus, the mitigation proposals do not indicate a change in the design of the program to assure that such problems will be avoided in the future. The continued choice of intensive use of pesticides indicates instead that these problems will remain.

Response: Although resolutions were found in each case, some of these were not clearly documented during the first year. The program's recordkeeping is now much improved, allowing any complaint to be closely monitored from time of receipt until resolution. The discussions of corrective actions have been expanded in appendix I.

Comment 29UU: On the issue of mitigation, the 1991 Alabama Supplement merely indicates that mitigation measures are provided in table 2-1 of the Draft EIS. In addition to those measures described in the table, azinphos-methyl will not be used in Alabama. As indicated in our Comments on the 1989 Draft EIS, the mitigation procedures proposed in the draft EIS are wholly inadequate to meet the requirements of the NEPA regulations or the terms of the Stipulation of Settlement. We rely in full on our analysis of the inadequacy of the mitigation procedures as set forth in our 1989 Comments.

Response: APHIS believes that the mitigation measures in table 2-2 (chapter 2) are sufficient to meet the requirements of NEPA.

Comment 29VV: We would also underscore the fact that the Stipulation of Settlement specifically requires the agency to include an analysis of any instance in which mitigation procedures were unsuccessful in the past, why proposed mitigation procedures will be more effective, and a comparison of whether the mitigation procedures are more rigorous than previous

mitigation procedures proposed. Again, in neither set of documents has the USDA addressed the reasons why the previous mitigation procedures that were in force during the 1987 and 1988 spraying failed, and no such analysis appears to be forthcoming.

Response: Appendix I addresses reasons why several mitigation measures were not effective earlier in the program.

Comment 29XX: It is also disturbing that the mitigation techniques proposed are not as protective even as those agreed to by the USDA in the Stipulation of Settlement. The USDA agreed in the Stipulation to treat borders contiguous to sensitive areas with ground equipment, to limit aerial applications to an altitude not to exceed five feet, and to prohibit aerial applications when wind velocity exceeds eight miles per hour. Now, by contrast, there is no set rule in the documents for use of ground equipment near sensitive areas; aerial applications are allowed to be made during wind speeds of up to ten miles per hour, as opposed to eight miles; and aerial applications may occur at altitudes between five and twelve feet, as opposed to five feet, thus increasing, rather than alleviating, the risk of pesticide drift.

Response: According to the Stipulation of Settlement, these extra measures were only applicable for the 21 southernmost counties in Alabama. APHIS is continuing to comply with those more stringent mitigation measures while completing the final EIS.

Comment 29YY: Nor is the additional "mitigation" measure of the elimination of azinphos-methyl adequate. We agree that azinphosmethyl should not be used. But it makes no sense to substitute yet an even more toxic pesticide, methyl parathion, for azinphosmethyl. Instead, it is time for the agency to take a fresh and objective look at its approach to the control of the boll weevil, to consider a true IPM approach, and to move away from the intensive use of insecticides.

Response: In certain areas of the program, the presence and protection of aquatic threatened and endangered species is of special concern. In these limited areas the use of methyl parathion should pose a lesser risk to the species than using either malathion or azinphos-methyl. With the prescribed mitigation measures regarding human health, the use of methyl parathion in these few instances is a feasible control alternative.

As mentioned above, IPM cannot achieve the stated goal of the program. However, in the absence of the boll weevil, many of the benefits of IPM can be realized, as they are now in Virginia, North Carolina, South Carolina, California, and Arizona.

Comment 29ZZ: In the 1991 Alabama Supplement, the USDA identifies the reduction or elimination of beneficial insect populations as an unavoidable environmental effect. As stated above, the USDA does not consider in the document the consequences associated with the elimination of

beneficial insect populations if eradication does not occur within three and a half years, or at all, and if intensive pesticide use continues.

Response: The section on unavoidable impacts has been expanded to include other potential impacts (see chapter 4). The impacts on beneficial insects are likely to be similar to those discussed, even if the program lasts more than 3½ years. Most pesticide applications and the greatest potential for impacts will occur during the first 2 years of the program.

Comment 29AAA: In conclusion, we reiterate our serious concern that the USDA has not adhered to the terms of the Stipulation of Settlement and the NEPA regulations. We hope that the USDA will correct these deficiencies in the Final EIS.

Response: APHIS feels that the substantial revisions made in the final EIS and appendices will meet both NEPA regulations and the Stipulation of Settlement.

Comment Letter Number 30

From:

James H. Lee
Office of the Secretary
Office of Environmental Affairs
U.S. Department of the Interior
The Richard B. Russell Federal Building
75 Spring St., SW
Atlanta, GA 30303

Comment 30A: Appendix B page 27 - The status of the leafy prairie-clover should be changed from proposed endangered to endangered (56 FR 19953, May 1, 1991).

Response: The tables in appendices H and I have been updated in response to your comment.

Comment 30B: Appendix B pages 42-43 - The analysis of program impacts for the Alabama cavefish should be modified to reflect the following concerns for potential threats to the species' aquatic habitat. Information available to the Fish and Wildlife Service indicates that cave dwelling aquatic species may be highly susceptible to effects from pesticide contamination because: 1) dye tracing studies for caves containing cavefish suggest that contaminants displaced into aquatic systems feeding caves can travel as much as 1 mile per day, and cave ecosystems and their associated recharge areas do not filter contaminants entering the system but transport them instead, 2) it has been estimated that due to their lower metabolic rates, cave dwelling aquatic species that are

killed by a contaminant could take 15-20 years to recover population numbers after one poisoning event, and 3) water temperatures within cave ecosystems average about 58-60°F - these lower temperatures would cause pesticides that enter a cave's water supply to decompose at a slower rate than if in an above-ground surface water, thus a pesticide that poses a hazard may be present in a cave system for a longer period of time.

Response: APHIS is aware of the special considerations required by cave-dwelling endangered and threatened species. Protection measures for these species include mapping the recharge zone for the cave in consultation with local officials. APHIS feels that these measures should provide sufficient protection for these species.

Comment 30C:

Appendix B page 49 - The status of the inflated heelsplitter mussel should be changed from proposed threatened to threatened (55 FR 39868, September 28, 1990). The analysis of program impacts for the inflated heelsplitter mussel, as well as all of the other species of mussels presented in the document, should make note of the concern that the mussels, larval glochidia and host fish (particularly early life stages) may be highly vulnerable to the effects of pesticides. The glochidia and host fish are essential to the survival of mussel species.

Response: The tables in appendices H and I have been updated according to your comment. In analyzing impacts to endangered and threatened mussels, both host fish and glochidia were taken into account.

Comment 30D:

Appendix B page 61 - The analysis of program impacts for the Alabama cave shrimp should note the same concerns for potential contaminant threats to cave dwelling aquatic species as was mentioned previously in the comments on the Alabama cavefish. The potential for contamination of the cave shrimp habitat and water supply is of great concern because of the approximately 30,000 acres of cotton grown in Madison County, Alabama, where Key Cave is located.

Response: See the response to comment 30A.

Comment 30E:

Two additional species, the goldline darter (*Percina aurolineata*) and the blue shiner (*Cyprinella caerula*), have proposed threatened status (56 FR 16054, April 19, 1991). The goldline darter occurs in the Cahaba River system, Alabama, and in fragmented populations in the Coosa River system. The blue shiner occurs in the Coosa River system. Both of these species should be analyzed for program impacts if they occur in cotton producing counties.

Response: In order to complete the ESA section 7 coordination in a timely manner, FWS and APHIS agreed to a cut-off date of April 1991 for the addition of newly listed species and habitats. No further work is being planned for the current Biological Assessment. However,

future consultations will be required to take into account new listings and new cotton-producing counties.

Comment Letter Number 31

From:

Jonathan Deason
Office of the Secretary
Office of Environmental Affairs
U.S. Department of the Interior
Washington, DC 20240

Comment 31A: We have reviewed the 1991 supplement to draft environmental impact statement regarding the analysis and protection of endangered and threatened species for the National Boll Weevil Cooperative Control Program. We understand the Animal and Plant Health Inspection Service (APHIS) has already determined that the program may affect endangered and threatened species and that you are in formal consultation with the Fish and Wildlife Service pursuant to Section 7 of the Endangered Species Act. Comments will be provided within the context of this consultation. Please contact Mr. James W. Pulliam, Regional Director, 75 Spring Street, S.W., Atlanta, Georgia 30303.

Response: Thank you for your comment. APHIS is continuing the section 7 consultation process with FWS.

Comment Letter Number 32

From:

Kenneth W. Holt
National Center for Environmental Health and Injury Control
Centers for Disease Control
Department of Health and Human Service
Public Health Service, MS F29
Atlanta, GA 30333

Comment 32A:

We have completed our review of the supplement to the Draft Environmental Impact Statement (DEIS) for the National Boll Weevil Cooperative Control Program. We are responding on behalf of the U.S. Public Health Service.

We have reviewed the Draft EIS for potential adverse impacts on human health. We believe that potential adverse impacts and appropriate mitigation measures have been addressed in this DEIS. Proper precautions in handling and applying prescribed chemicals and regular cholinesterase testing of program personnel and contract applicators as planned are important measures toward limiting overexposure. Procedures must be closely monitored by regulatory authorities to ensure that public exposures to insecticides are prevented or minimized to protect health.

Thank you for the opportunity to review and comment on this document. Please ensure that we are included on your mailing list to receive a copy of the Final EIS, and future EISs which may indicate potential public health impact and are developed under the National Environmental Policy Act.

Response: Thank you for your comment. You have been added to our mailing list.

Comment Letter Number 33

From:

Richard E. Sanderson
Environmental Protection Agency
Washington, DC 20460

Comment 33A:

EPA's major objection is that the eradication program relies heavily on the use of pesticides to control the boll weevil. While the preferred alternative will encourage cultural and biological controls, the main

control method will be multiple applications of pesticides over several years. These multiple applications will likely result in the contamination of streams, ponds, and estuaries. It is also likely to cause adverse effects to many non-target species and natural resources.

Response: The preferred alternative uses the most effective combination of methods to achieve the stated objective. Currently, cultural and biological controls are not as effective as chemical methods in eliminating the boll weevil. The analysis indicates that the effects of the program chemicals on water resources will be short-lived. Although APHIS uses pesticides to control the boll weevil, the goal is eradication and there will be a decrease in overall pesticide use once the goal is achieved. See the discussion on economic benefits of boll weevil eradication in chapter 4.

Comment 33B:

In our comments on the draft EIS, EPA recommended that, because of their high toxicity, encapsulated methyl parathion and azinphos-methyl not be used. It is EPA's understanding that azinphos-methyl will not be used, but a microencapsulated formulation of methyl parathion will be used. EPA still has concerns that the latter product's use may result in losses of non-target species and contamination of water, and will increase the risks to applicators and the public. It would be useful to discuss in the Final EIS how APHIS will ensure that the use of methyl parathion will not result in environmental and health problems.

Response: Both methyl parathion and azinphos-methyl are evaluated for potential program use in the EIS. Azinphos-methyl is not being used in Alabama. The potential for these chemicals to affect water resources, nontarget species, and human health has been adequately addressed in the EIS.

Comment 33E:

We also recommended in our previous comments that APHIS explore other alternatives that combine the most effective elements of available controls, cultural practices, and new chemical formulations. Based on our review of the supplement, we believe that more emphasis should be given to these alternatives.

Response: The preferred alternative combines the most effective methods now available. As innovations in boll weevil control become available, these elements will be assessed and included as a part of future programs, if warranted.

Comment 33F:

The DEIS relies on the Draft EIS for describing mitigation measures for the program. Consequently, we continue to suggest that the final EIS describe in more detail how the detrimental impacts of pesticide use, other control methods and the cumulative effects of the Boll Weevil Control Program will be minimized. Specific mitigative measures should be developed that protect farm workers, the public, bees, other nontarget species, and other natural resources.

Response: APHIS feels that its standard operational procedures and its current mitigation measures will effectively minimize adverse impacts to workers, the public, and other resources. (More restrictive mitigation measures will hinder the achievement of the program's goal of eradication.)

Comment 33G:

EPA is pleased that the discussions of mitigation procedures to protect endangered species have been considered in considerably more detail. We assume that APHIS will continue to work with the Fish and Wildlife Service to ensure protection for endangered species. To assess the effectiveness of all mitigation measures, we continue to recommend that a monitoring program be developed.

Response: APHIS is continuing its consultation with the Fish and Wildlife Service, and the results of this will be incorporated in the Record of Decision on this document. APHIS has conducted environmental monitoring programs during all its past boll weevil program activities and will continue to do so.

Comment 33H:

The supplement's more realistic version of the farm pond scenario is an improvement over the Draft EIS version. The revision is more realistic because it uses four different scenarios to calculate concentrations of insecticides in a circular farm pond one acre in area and two feet in depth.

Response: Thank you for your comment.

Comment 33I:

In reference to the summaries of the risks to representative wildlife and aquatic species (Tables A26-A31), EPA generally uses 1/5 LC_{50} to determine risk to nonendangered terrestrial wildlife species and 1/10 LC_{50} to determine risk to nonendangered aquatic species. The summaries, however, use LD_{50}s to determine these risks. EPA believes that the LC_{50} is a more realistic measure of risk to nonendangered species. Additionally, the scale represented on page A-30 is inconsistent with the text of the supplement. The scale suggests that significant risks are expected at doses greater than or equal to LC_{50}, while the text suggests that these risks are assumed to present an unacceptable risk at LD_{50}.

Response: APHIS has used the LC_{50} values for assessing risk to nonendangered aquatic species. However, LC_{50} values are not always available for terrestrial species. APHIS has calculated exposure based on the total body burden, not simply a dietary exposure. The scale on page A-30 has been revised in response to your comment.

Comment 33J:

The supplement dealing with risk assessments for terrestrial and aquatic species use indicator species that do not always belong to the same class as the representative species (i.e., an LD_{50} value for the bobwhite quail was used to calculate risk for the eastern hognose snake). EPA believes that "between class" comparisons may not be the best means of determining risk. We are aware that, as in the above example, a surrogate species had to be used because there were no

toxicity data available for reptiles or a closely related species. In other instances, however, a vastly different surrogate species was used when toxicity data existed for a more closely related species. One such example is the risk assessment for methyl parathion for two species of mussels when toxicity data exist for the eastern oyster.

Response: APHIS has used the closest available species for toxicity surrogates in this nontarget species risk assessment. Methyl parathion toxicity data was not found for the oyster or any other mollusk species; if EPA would provide the citation for this information, we would be able to include it in the risk assessment.

Comment 33K:

EPA uses an invertebrate species (i.e., *Daphnia magna*) to calculate risk for a mollusk species when no other data exist. Birds usually serve as representative species for reptiles as little toxicity data exist for these species. In the supplement, however, birds were used to calculate risks for the terrestrial reptile species only. The aquatic reptiles, such as turtles, were represented by tadpoles or fish. For species such as turtles, it is more accurate to use birds as a representative species as they tend to be exposed to pesticide in a similar manner (i.e. through intake of food or water). Fish and tadpoles are mainly exposed to pesticides dermally or through the gills.

Response: Aquatic species such as fish and tadpoles are generally more sensitive to pesticides than birds, so using these species as surrogates is in keeping with the conservative nature of this risk assessment. Using fish or tadpoles as surrogates for aquatic reptiles is also conservative in that the dose to fish or tadpoles is likely to be higher than the dose to reptiles.

Comment 33L:

In reference to Tables A26-A31, a number of values could not be checked as no reference was made to their source. Although EPA concurs with most of the other values, there are a few exceptions. In Table A-29, the EC_{50} values for the American oyster is 9.070 ppm, while EPA's records show a value of 1.00 ppm. In Table A-30, the EC_{50} values for the scud and stonefly are results of formulated product testing (25% a.i.) while the rest of the values are from technical product testing.

Response: The only value found in the data search for azinphos-methyl toxicity to the oyster was 9.070 ppm. All of the toxicity values in Table A-30 are the results of formulated product testing (see table heading).

Comment Letter Number 34

From:

James W. Pulliam
Fish and Wildlife Service
The Richard B. Russell Federal Building
75 Spring Street SW
Atlanta, GA 30303

Comment 34A: Page 2-22, 3rd paragraph. Where is documentation that indicates relaxation of weather parameters and wind speeds with respect to ground application should be acceptable? (Refer to Atochem report for both ground and aerial drift). Wouldn't it be less confusing if application wind speeds were the same for both ground and aerial application as well as weather regimes?

Response: The applicators used in the program are either certified pesticide applicators or in direct contact with a certified applicator. Most ground applications can be made effectively and without adverse drift at slightly higher wind speeds because application parameters (nozzle height, angle, direction of application relative to wind) can be adjusted to force spray directly into the canopy. Conversely, conditions at lower wind speeds may force ground applicators to stop if the chemical cannot be applied effectively. APHIS instructs its applicators to use their best judgement as to the proper conditions for chemical applications. The guidelines set out in the operational procedures are an outside limit for safe and effective application conditions.

Comment 34B: Page 2-29. Under nontarget aquatic species, document indicates diflubenzuron is not likely to affect aquatic species, yet numerous studies report diflubenzuron is highly toxic to a number of aquatic invertebrates (reference the two cited papers attached).

Response: These statements have been changed in response to your comments.

Comment 34C: ASA 4-4. Under the risk assessment conclusion for aquatic species, it is stated diflubenzuron is not likely to affect any aquatic species, yet this statement is contradicted on page 5-1, 3rd paragraph, 2nd sentence, where it states "diflubenzuron is highly toxic to aquatic invertebrates". This is repeated again on B-18, 2nd sentence.

Response: These sections have been clarified in response to your comment.

Comment 34D: ASA, page A-16, 2nd paragraph, 1st sentence. Are these neat applications with the mist blower? If not, using a tank mix four days old would present problems with respect to malathion since a half-life of

three days is normally the case with this chemical, thus making it less effective as a control agent, if not mixed and sprayed fresh everyday.

Response: Malathion ULV is generally used in aircraft and mist blowers. Malathion RTU may be mixed with water in hiboys. In those instances the pH of the water is monitored and adjusted, if necessary, and the entire tank mix is usually applied in 1 day.

Comment 34E: ASA, page A-38, Table A-30. Daphnia should be included under invertebrates in the farm pond scenario.

Response: This information has been added to the nontarget species risk assessment in response to your comment.

Comment 34F: APETS. Under the aquatic species exposure analysis, page 3-7, 3rd paragraph under drift scenario, 2nd sentence is confusing. The way it reads, only half the pond would receive drift when in fact the whole pond would receive spray drift.

Response: This section has been clarified in response to your comment.

Appendix E

Estimated Annual Acreage and Costs for the Boll Weevil Cooperative Control Programs

Estimated annual acreage and costs for each increment are shown in this appendix by control method and program alternative. Tables E-1 through E-5 show estimated acres treated in eradication and suppression programs. Tables E-6 through E-16 show estimated costs for eradication and suppression programs.

Table E-1. Acres Treated by the Mechanical Control Method in an ERADICATION Program (thousands of acres)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4	0	0.3	4.5	0																		
5				0	1.5	25.7	0															
6							0	1.7	28.5	0												
7										0	0.2	3.5	0									
8													0	0.4	7.6	0						
9																0	1.5	25.9	0			
10																			0	0.5	8.1	0
Total	0	0.3	4.5	0	1.5	25.7	0	1.7	28.5	0	0.2	3.5	0	0.4	7.6	0	1.5	25.9	0	0.5	8.1	0

Table E-2. Acres Treated by the Sterile Insect Control Method in an ERADICATION Program (thousands of acres)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4	0	15.7	15.7	0																		
5				0	15.7	15.7	0															
6							0	15.7	15.7	0												
7										0	15.7	15.7	0									
8													0	15.7	15.7	0						
9																0	15.7	15.7	0			
10																			0	15.7	15.7	0
Total	0	15.7	15.7	0	15.7	15.7	0	15.7	15.7	0	15.7	15.7	0	15.7	15.7	0	15.7	15.7	0	15.7	15.7	0

Table E-3. Acres Treated by Chemical Control Method in an ERADICATION Program (thousands of acres)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4	40	200	100	0																		
5				226	1,131	565	0															
6							251	1,254	627	0												
7										31	155	78	0									
8													67	333	166	0						
9																228	1,140	570	0			
10																			71	357	179	0
Total	40	200	100	226	1,131	565	251	1,254	627	31	155	78	67	333	166	228	1,140	570	71	357	179	0

Table E-4. Acres Treated by Chemical Control Method in a SUPPRESSION Program With FULL Federal Involvement (thousands of acres)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432
12	173	173	173	173	173	173	173	173	173	173	173	173	173	173	173
1&2				213	213	213	213	213	213	213	213	213	213	213	213
11				38	38	38	38	38	38	38	38	38	38	38	38
4							200	200	200	200	200	200	200	200	200
13							555	555	555	555	555	555	555	555	555
5										1,131	1,131	1,131	1,131	1,131	1,131
6													1,254	1,254	1,254
7															
8															
9															
10															
14															
Total	605	605	605	856	856	856	1,611	1,611	1,611	2,742	2,742	2,742	3,996	3,996	3,996

Increment	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
3	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432
12	173	173	173	173	173	173	173	173	173	173	173	173	173	173	173
1&2	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213
11	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
4	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
13	555	555	555	555	555	555	555	555	555	555	555	555	555	555	555
5	1,131	1,131	1,131	1,131	1,131	1,131	1,131	1,131	1,131	1,131	1,131	1,131	1,131	1,131	1,131
6	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254
7	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115
8				333	333	333	333	333	333	333	333	333	333	333	333
9							950	950	950	950	950	950	950	950	950
10										357	357	357	357	357	357
14													270	270	270
Total	4,111	4,111	4,111	4,444	4,444	4,444	5,394	5,394	5,394	5,751	5,751	5,751	6,021	6,021	6,021

Table E-5. Acres Treated by Chemical Control Method in a SUPPRESSION Program With LIMITED Federal Involvement (thousands of acres)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	432	432	432												
12	173	173	173												
1 & 2				213	213	213									
11				38	38	38									
4							200	200	200						
13							555	555	555						
5										1,131	1,131	1,131			
6													1,254	1,254	1,254
7															
8															
9															
10															
14															
Total	605	605	605	251	251	251	755	755	755	1,131	1,131	1,131	1,254	1,254	1,254

Increment	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
3															
12															
1&2															
11															
4															
13															
5															
6															
7	115	115	115												
8				333	333	333									
9							950	950	950						
10										357	357	357			
14													270	270	270
Total	115	115	115	333	333	333	950	950	950	357	357	357	270	270	270

Note: Growers would continue to apply their own treatments in subsequent years.

Table E-6. Costs for the Mechanical Control Method in an ERADICATION Program (thousands of dollars)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4	0	8	113	0																		
5				0	38	646	0															
6							0	43	716	0												
7										0	5	88	0									
8													0	10	191	0						
9																0	38	651	0			
10																			0	13	204	0
Total	0	8	113	0	38	646	0	43	716	0	5	88	0	10	191	0	38	651	0	13	204	0

Table E-7. Costs for the Sterile Insect Control Method in an ERADICATION Program (thousands of dollars)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4	0	3,925	3,925	0																		
5				0	3,925	3,925	0															
6							0	3,925	3,925	0												
7										0	3,925	3,925	0									
8													0	3,925	3,925	0						
9																0	3,925	3,925	0			
10																			0	3,925	3,925	0
Total	0	3,925	3,925	0	3,925	3,925	0	3,925	3,925	0	3,925	3,925	0	3,925	3,925	0	3,925	3,925	0	3,925	3,925	0

Table E-8. Insecticide and Application Costs for Chemical Control Method in an ERADICATION Program (thousands of dollars)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4	762	7,541	1,906	0																		
5				4,309	42,625	10,772	0															
6							4,779	47,291	11,950	0												
7										591	5,845	1,477	0									
8													1,267	12,537	3,169	0						
9																4,345	42,984	10,862	0			
10																			1,361	13,462	3,401	0
Total	762	7,541	1,906	4,309	42,625	10,772	4,779	47,291	11,950	591	5,845	1,477	1,267	12,537	3,169	4,345	42,984	10,862	1,361	13,462	3,401	0

Table E-9. Trap Surveying Costs for Chemical Control Method in an ERADICATION Program (thousands of dollars)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4	2,280	2,784	2,784	181																		
5				12,885	15,737	15,737	1,026															
6							14,295	17,458	17,458	1,137												
7										1,767	2,158	2,158	141									
8													3,790	4,628	4,628	302						
9																12,994	15,869	15,869	1,034			
10																			4,069	4,969	4,969	324
Total	2,280	2,784	2,784	13,066	15,737	15,737	15,321	17,458	17,458	2,904	2,158	2,158	3,931	4,628	4,628	13,296	15,869	15,869	5,103	4,969	4,969	324

Table E-10. Other Control Costs in an ERADICATION Program (thousands of dollars)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4	1,417	3,087	2,044	0																		
5				3,360	12,798	6,900	0															
6							3,617	14,089	7,544	0												
7										1,324	2,618	1,809	0									
8													1,694	4,470	2,736	0						
9																3,379	12,897	6,949	0			
10																			1,745	4,726	2,863	0
Total	1,417	3,087	2,044	3,360	12,798	6,900	3,617	14,089	7,544	1,324	2,618	1,809	1,694	4,470	2,736	3,379	12,897	6,949	1,745	4,726	2,863	0

Table E-11. Insecticide and Application Costs for Chemical Control Method in a SUPPRESSION Program With FULL Federal Involvement (thousands of dollars)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	10,235	14,259	10,235	8,223	14,259	10,235	14,259	10,235	8,223	14,259	10,235	14,259	10,235	8,223	14,259
12	4,101	5,713	4,101	3,295	5,713	4,101	5,713	4,101	3,295	5,713	4,101	5,713	4,101	3,295	5,713
1 & 2				5,052	7,038	5,052	4,059	7,038	5,052	7,038	5,052	4,059	7,038	5,052	7,038
11				904	1,259	904	726	1,259	904	1,259	904	726	1,259	904	1,259
4							4,744	6,609	4,744	3,811	6,609	4,744	6,609	4,744	3,811
13							13,164	18,339	13,164	10,576	18,339	13,164	18,339	13,164	10,576
5										26,814	37,355	26,814	21,543	37,355	26,814
6													29,747	41,442	29,747
7															
8															
9															
10															
14															
Total	14,336	19,972	14,336	17,474	28,269	20,292	42,665	47,581	35,382	69,470	82,595	69,479	98,871	114,179	99,217

Increment	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
3	10,235	14,259	10,235	8,223	14,259	10,235	14,259	10,235	8,223	14,259	10,235	14,259	10,235	8,223	14,259
12	4,101	5,713	4,101	3,295	5,713	4,101	5,713	4,101	3,295	5,713	4,101	5,713	4,101	3,295	5,713
1&2	5,052	4,059	7,038	5,052	7,038	5,052	4,059	7,038	5,052	7,038	5,052	4,059	7,038	5,052	7,038
11	904	726	1,259	904	1,259	904	726	1,259	904	1,259	904	726	1,259	904	1,259
4	6,609	4,744	6,609	4,744	3,811	6,609	4,744	6,609	4,744	3,811	6,609	4,744	6,609	4,744	3,811
13	18,339	13,164	18,339	13,164	10,576	18,339	13,164	18,339	13,164	10,576	18,339	13,164	18,339	13,164	10,576
5	37,355	26,814	21,543	37,355	26,814	37,355	26,814	21,543	37,355	26,814	37,355	26,814	21,543	37,355	26,814
6	23,900	41,442	29,747	41,442	29,747	23,900	41,442	29,747	41,442	29,747	23,900	41,442	29,747	41,442	29,747
7	2,728	3,800	2,728	2,192	3,800	2,728	3,800	2,728	2,192	3,800	2,728	3,800	2,728	2,192	3,800
8				7,887	10,987	7,887	6,336	10,987	7,887	10,987	7,887	6,336	10,987	7,887	10,987
9							22,533	31,392	22,533	18,103	31,392	22,533	31,392	22,533	18,103
10										8,468	11,797	8,468	6,803	11,797	8,468
14													6,404	8,922	6,404
Total	109,223	114,721	101,599	124,258	114,004	117,110	143,590	143,978	146,791	140,575	160,299	152,058	157,185	167,510	146,979

Table E-12. Insecticide and Application Costs for Chemical Control Method in a SUPPRESSION Program With LIMITED Federal Involvement (thousands of dollars)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	10,235	14,259	10,235												
12	4,101	5,713	4,101												
1 & 2				5,052	7,038	5,052									
11				904	1,259	904									
4							4,744	6,609	4,744						
13							13,164	18,339	13,164						
5										26,814	37,355	26,814			
6													29,747	41,442	29,747
7															
8															
9															
10															
14															
Total	14,336	19,972	14,336	5,956	8,297	5,956	17,908	24,948	17,908	26,814	37,355	26,814	29,747	41,442	29,747

Increment	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
3															
12															
1&2															
11															
4															
13															
5															
6															
7	2,728	3,800	2,728												
8				7,887	10,987	7,887									
9							22,533	31,392	22,533						
10										8,468	11,797	8,468			
14													6,404	8,922	6,404
Total	2,728	3,800	2,728	7,887	10,987	7,887	22,533	31,392	22,533	8,468	11,797	8,468	6,404	8,922	6,404

Note: Growers would continue to apply their own treatments in subsequent years.

Table E-13. Trap Surveying Costs for Chemical Control Method in a SUPPRESSION Program With FULL Federal Involvement (thousands of dollars)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918
12	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971
1 & 2				2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428
11				6,326	6,326	6,326	434	434	434	434	434	434	434	434	434
4							2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280
13							6,326	6,326	6,326	6,326	6,326	6,326	6,326	6,326	6,326
5										12,885	12,885	12,885	12,885	12,885	12,885
6													14,295	14,295	14,295
7															
8															
9															
10															
14															
Total	6,889	6,889	6,889	9,751	9,751	9,751	18,357	18,357	18,357	31,242	31,242	31,242	45,537	45,537	45,537

Increment	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
3	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918	4,918
12	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971	1,971
1&2	2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428	2,428
11	434	434	434	434	434	434	434	434	434	434	434	434	434	434	434
4	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280
13	6,326	6,326	6,326	6,326	6,326	6,326	6,326	6,326	6,326	6,326	6,326	6,326	6,326	6,326	6,326
5	12,885	12,885	12,885	12,885	12,885	12,885	12,885	12,885	12,885	12,885	12,885	12,885	12,885	12,885	12,885
6	14,295	14,295	14,295	14,295	14,295	14,295	14,295	14,295	14,295	14,295	14,295	14,295	14,295	14,295	14,295
7	1,311	1,311	1,311	1,311	1,311	1,311	1,311	1,311	1,311	1,311	1,311	1,311	1,311	1,311	1,311
8				3,790	3,790	3,790	3,790	3,790	3,790	3,790	3,790	3,790	3,790	3,790	3,790
9							10,828	10,828	10,828	10,828	10,828	10,828	10,828	10,828	10,828
10										4,069	4,069	4,069	4,069	4,069	4,069
14													3,078	3,078	3,078
Total	46,848	46,848	46,848	50,638	50,638	50,638	61,466	61,466	61,466	65,535	65,535	65,535	68,613	68,613	68,613

Table E-14. Trap Surveying Costs for Chemical Control Method in a SUPRESSION Program With LIMITED Federal Involvement (thousands of dollars)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	4,918	4,918	4,918												
12	1,971	1,971	1,971												
1 & 2				2,428	2,428	2,428									
11				434	434	434									
4							2,280	2,280	2,280						
13							6,326	6,326	6,326						
5										12,885	12,885	12,885			
6													14,295	14,295	14,295
7															
8															
9															
10															
14															
Total	6,889	6,889	6,889	2,862	2,862	2,862	8,606	8,606	8,606	12,885	12,885	12,885	14,295	14,295	14,295

Increment	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
3															
12															
1&2															
11															
4															
13															
5															
6															
7	1,311	1,311	1,311												
8				3,790	3,790	3,790									
9							10,828	10,828	10,828						
10										4,069	4,069	4,069			
14													3,078	3,078	3,078
Total	1,311	1,311	1,311	3,790	3,790	3,790	10,828	10,828	10,828	4,069	4,069	4,069	3,078	3,078	3,078

Table E-15. Other Control Costs in a SUPPRESSION Program With FULL Federal Involvement (thousands of dollars)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503
12	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804
1 & 2				3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223
11				1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398
4							3,087	3,087	3,087	3,087	3,087	3,087	3,087	3,087	3,087
13							6,792	6,792	6,792	6,792	6,792	6,792	6,792	6,792	6,792
5										12,798	12,798	12,798	12,798	12,798	12,798
6													14,089	14,089	14,089
7															
8															
9															
10															
14															
Total	8,307	8,307	8,307	12,928	12,928	12,928	22,807	22,807	22,807	35,605	35,605	35,604	49,694	49,694	49,694

Increment	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
3	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503
12	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804
1&2	3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223	3,223
11	1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398	1,398
4	3,087	3,087	3,087	3,087	3,087	3,087	3,087	3,087	3,087	3,087	3,087	3,087	3,087	3,087	3,087
13	6,792	6,792	6,792	6,792	6,792	6,792	6,792	6,792	6,792	6,792	6,792	6,792	6,792	6,792	6,792
5	12,798	12,798	12,798	12,798	12,798	12,798	12,798	12,798	12,798	12,798	12,798	12,798	12,798	12,798	12,798
6	14,089	14,089	14,089	14,089	14,089	14,089	14,089	14,089	14,089	14,089	14,089	14,089	14,089	14,089	14,089
7	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200
8				4,470	4,470	4,470	4,470	4,470	4,470	4,470	4,470	4,470	4,470	4,470	4,470
9							10,914	10,914	10,914	10,914	10,914	10,914	10,914	10,914	10,914
10										4,726	4,726	4,726	4,726	4,726	4,726
14													3,818	3,818	3,818
Total	51,894	51,894	51,894	56,364	56,364	56,364	67,278	67,278	67,278	72,004	72,004	72,004	75,822	75,822	75,822

Table E-16. Other Costs in a SUPPRESSION Program With LIMITED Federal Involvement (thousands of dollars)

Increment	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	5,503	5,503	5,503												
12	2,804	2,804	2,804												
1 & 2				3,223	3,223	3,223									
11				1,398	1,398	1,398									
4							3,087	3,087	3,087						
13							6,792	6,792	6,792						
5										12,798	12,798	12,798			
6													14,089	14,089	14,089
7															
8															
9															
10															
14															
Total	8,307	8,307	8,307	4,621	4,621	4,621	9,879	9,879	9,879	12,798	12,798	12,798	14,089	14,089	14,089

Increment	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
3															
12															
1&2															
11															
4															
13															
5															
6															
7	2,200	2,200	2,200												
8				4,470	4,470	4,470									
9							10,914	10,914	10,914						
10										4,726	4,726	4,726			
14													3,818	3,818	3,818
Total	2,200	2,200	2,200	4,470	4,470	4,470	10,914	10,914	10,914	4,726	4,726	4,726	3,818	3,818	3,818

Appendix F

Common and Scientific Names of Nontarget Species

Introduction

Table F-1 contains a list of the common and scientific names for representative wildlife and vegetation species found in the Southeast, South Central, and Southwest program areas. The list was compiled from numerous sources, which are listed in the references section following the appendixes. Although the species are known to occur in the program areas, they are not necessarily found in or near cotton fields. The presence of a listed species in or near a cotton field depends on where the cotton field is located in relation to the species' range and the type of habitats surrounding the cotton field in relation to the species' preferred habitat.

Table F-1. Common and Scientific Names of Nontarget Species

Common name	Scientific name
SOUTHEAST WILDLIFE	
Mammals:	
Bat, gray	*Myotis grisescens*
Cottontail, eastern	*Sylvilagus floridanus*
Deer, white-tailed	*Odocoileus virginianus*
Fox, gray	*Urocyon cinereoargenteus*
Fox, red	*Vulpes vulpes*
Mink	*Mustela vison*
Mole, eastern	*Scalopus aquaticus*
Mouse, cotton	*Peromyscus gossypinus*
Mouse, golden	*Peromyscus nuttalli*
Opossum	*Didelphis virginiana*
Otter, river	*Lutra canadensis*
Rabbit, swamp	*Sylvilagus aquaticus*
Raccoon	*Procyon lotor*
Shrew, least	*Cryptotis parva*
Shrew, short-tailed	*Blarina brevicauda*
Shrew, southeastern	*Sorex longirostris*
Skunk, spotted	*Spilogale putorius*
Skunk, striped	*Mephitis mephitis*
Woodrat, eastern	*Neotoma floridana*
Birds:	
Bobwhite, northern	*Colinus virginianus*
Cardinal, northern	*Cardinalis cardinalis*
Chat, yellow-breasted	*Icteria virens*
Eagle, bald	*Haliaeetus leucocephalus*

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
Birds (continued):	
Killdeer	*Charadrius vociferus*
Kingbird, eastern	*Tyrannus tyrannus*
Martin, purple	*Progne subis*
Meadowlark, eastern	*Sturnella magna*
Mockingbird	*Mimus polyglottos*
Oriole, orchard	*Icterus spurius*
Sparrow, field	*Spizella pusilla*
Thrasher, brown	*Toxostoma rufum*
Reptiles and Amphibians:	
Bullfrog	*Rana catesbeiana*
Cottonmouth	*Agkistrodon piscivorus*
Eel, conger	*Amphiuma means*
Frog, northern cricket	*Acris crepitans*
Newts, eastern	*Notophthalmus* spp.
Rattlesnake, timber	*Crotalus horridus*
Racerunner, six-lined	*Cnemidophorus sexlineatus*
Salamander, dusky	*Desmognathus fuscus*
Snake, eastern hognose	*Heterodon platyrhinos*
Snake, rough green	*Opheodrys aestivus*
Snakes, water	*Nerodia* spp.
Toad, fowler's	*Bufo woodhousei fowleri*
Turtle, eastern box	*Terrapene carolina*
Turtles, mud	*Kinosternon* spp.
Waterdogs	*Necturus* spp.
Invertebrates:	
Aphid, cotton	*Aphis gossypii*
Armyworm, beet	*Spodoptera exigua*
Bee, honey	*Apis mellifera*
Beetle, Hercules	*Dynastes hercules*
Beetle, spotted lady	*Coleomegilla maculata*
Beetles, click	*Elateridae* spp.
Beetles, ladybird	*Coccinellidae* spp.
	Hipponamia spp.
Bollworm	*Heliothis zea*
Borer, European corn	*Ostrinia nubilalis*
Budworm, tobacco	*Heliothis virscens*
Bug, clouded plant	*Neurocolpus nubilis*
Bug, tarnished plant	*Lygus lineolaris*
Bugs, big-eyed	*Geocoris* spp.
Bugs, damsel	*Nabis* spp.
Butterfly, Diana	*Speyeria diana*
Butterfly, great purple hairstreak	*Atlides halesus*
Butterfly, white-m hairstreak	*Parrhasius m-album*
Butterfly, zebra	*Heliconius charitonius*
Caterpillar, saltmarsh	*Estigmene acrea*
Cricket, snowy field	*Oecanthus fultoni*

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
Invertebrates (continued):	
Cutworms, variegated	*Periodroma saucia*
Flea, sticktight	*Echidnophaga gallinacea*
Fleahopper, cotton	*Pseudotomosculis seriatus*
Flies, hover	*Syrphus* spp.
Grasshoppers	*Schistocerca* spp.
	Trimerotropis spp.
	Melanoplus spp.
Lacewings, brown	*Hemerobius* spp.
Lacewings, green	*Chrysopa* spp.
Leafworm, cotton	*Alabama argillacea*
Looper, cabbage	*Tricloplosia ni*
Looper, soybean	*Pseudoplusia includens*
Mite, spider	*Tetranychus* sp.
Perforator, cottonleaf	*Bucculatrix thurberiella*
Piratebugs, minute	*Orios* spp.
Scorpionfly	*Panorpa confusa*
Stinkbugs	*Nezara* spp.
Thrips	*Frankiniella occidentalis*
	Thrips spp.
	Sericothrips variabilis
Webworm, garden	*Achyra rantalis*
Fish:	
Bass, largemouth	*Micropterus salmoides*
Bass, smallmouth	*Micropterus dolomieu*
Bass, yellow	*Moronen mississippiensis*
Bluegill	*Lepomis macrochirus*
Catfish, blue	*Ictalurus furcatus*
Catfish, channel	*Ictalurus punctatus*
Crappie, black	*Pomoxis nigromaculatus*
Darter, blackside	*Percina maculata*
Darter, channel	*Percina copelandi*
Darter, river	*Percina shumardi*
Darter, tesselated	*Etheostoma olmstedi*
Gar, shortnose	*Lepisosteus platostomus*
Minnow, bluntnose	*Pimephales notatus*
Minnow, fathead	*Pimephales promelas*
Perch, yellow	*Perca flavescens*
Pickerel, chain	*Esox niger*
Pumpkinseed	*Lepomis gibbosus*
Sunfish, green	*Lepomis cyanellus*
Sunfish, redbreast	*Lepomis auritus*
Trout, brook	*Salvelinus fontinalis*

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
SOUTHEAST VEGETATION	
Trees:	
Ash, green	*Fraxinus pennsylvanica*
Ash, pumpkin	*Fraxinus profunda*
Ash, white	*Fraxinus americana*
Bay, sweet	*Magnolia virginiana*
Beech, American	*Fagus grandifolia*
Birch, river	*Betula nigra*
Cedar, eastern red	*Juniperus virginiana*
Cherry, black	*Prunus serotina*
Cottonwood, eastern	*Populus deltoides*
Cypress, bald	*Taxodium distichum*
Cyrilla, swamp	*Cyrilla racemiflora*
Dogwood, flowering	*Cornus florida*
Elm, American	*Ulmus americana*
Elm, water	*Planera aquatica*
Elm, winged	*Ulmus alata*
Gum, sweet	*Liquidambar styraciflua*
Hickory, bitternut	*Carya cordiformis*
Hickory, mockernut	*Carya tomentosa*
Hickory, pignut	*Carya glabra*
Hickory, shagbark	*Carya ovata*
Hickory, water	*Carya aquatica*
Holly, American	*Ilex opaca*
Hornbeam, American	*Carpinus caroliniana*
Hornbeam, eastern hop	*Ostrya virginiana*
Locust, water	*Gleditsia aquatica*
Magnolia, southern	*Magnolia grandiflora*
Maple, Florida	*Acer barbatum*
Maple, red	*Acer rubrum*
Mulberry, red	*Morus rubra*
Oak, black	*Quercus velutina*
Oak, blackjack	*Quercus marilandica*
Oak, bluejack	*Quercus incana*
Oak, Chapman	*Quercus chapmanii*
Oak, cherrybark	*Quercus falcata* var. *pagodaefolia*
Oak, chestnut	*Quercus prinus*
Oak, laurel	*Quercus laurifolia*
Oak, live	*Quercus virginiana*
Oak, myrtle	*Quercus myrtifolia*
Oak, northern red	*Quercus rubra*
Oak, overcup	*Quercus lyrata*
Oak, post	*Quercus stellata*
Oak, scarlet	*Quercus coccinea*
Oak, shumard	*Quercus shumardii*
Oak, southern red	*Quercus falcata*
Oak, swamp chestnut	*Quercus michauxii*
Oak, turkey	*Quercus laevis*

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
Trees (continued):	
Oak, water	*Quercus nigra*
Oak, white	*Quercus alba*
Oak, willow	*Quercus phellos*
Palmetto, cabbage	*Sabal palmetto*
Pecan	*Carya illinoensis*
Persimmon, common	*Diospyros virginiana*
Pine, loblolly	*Pinus taeda*
Pine, longleaf	*Pinus palustris*
Pine, pond	*Pinus serotina*
Pine, sand	*Pinus clausa*
Pine, shortleaf	*Pinus echinata*
Pine, slash	*Pinus elliottii*
Pine, spruce	*Pinus elliottii*
Pine, Virginia	*Pinus virginiana*
Poplar, yellow	*Liriodendron tulipifera*
Redbud, eastern	*Cercis canadensis*
Sassafras	*Sassafras albidum*
Sourwood	*Oxydendrum arboreum*
Sugarberry	*Celtis laevigata*
Sycamore	*Platanus occidentalis*
Tupelo, black	*Nyssa sylvatica*
Walnut, black	*Juglans nigra*
Willow, black	*Salix nigra*
Shrubs, Forbs, and Other Plants:	
Apple, gopher	*Chrysobalanus oblongifolia*
Arrowwood	*Viburnum dentatum*
Aster	*Aster* spp.
Beautyberry, American	*Callicarpa americana*
Blackberry	*Rubus* spp.
Blackhaw, rusty	*Viburnum rufidulum*
Blueberry, dryland	*Vaccinium vacillans*
Blueberry, ground	*Vaccinium myrsinites*
Buckeye, red	*Aesculus pavia*
Bush, button	*Cephalanthus occidentalis*
Cactus, prickly pear	*Opuntia humifusa*
Crabgrass	*Digitaris* spp.
Creeper, trumpet	*Campsis radicans*
Creeper, Virginia	*Parthenocissus quinquefolia*
Cross, St. Andrews	*Hypericum hypericoides*
Deerberry	*Vaccinium stamineum*
Devilwood	*Osmanthus americanus*
Dogfennel	*Eupatorium capillifolium*
Elder, American	*Sambucus canadensis*
Eupatoriums	*Eupatorium* spp.
Fern, bracken	*Pteridium aquilinium*
Fern, cinnamon	*Osmunda cinnamonea*
Fetterbush	*Lyonia lucida*

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
Shrubs, Forbs, and Other Plants (continued):	
Fringetree	*Chionanthus virginicus*
Gallberry, large	*Ilex coriacea*
Gallberry, smooth	*Ilex glabra*
Goldenrod	*Solidago* spp.
Grape, muscadine	*Vitis rotundifolia*
Grape, summer	*Vitis aestivalis*
Greenbrier, cat	*Smilax glauca*
Greenbrier, common	*Smilax rotundifolia*
Greenbrier, laurel	*Smilax laurifolia*
Greenbrier, saw	*Smilax bona-nox*
Hawthorns	*Crataegus* spp.
Holly, American	*Ilex opaca*
Honeysuckle, Japanese	*Lonicera japonica*
Ivy, poison	*Rhus radicans*
Jessamine, Carolina	*Gelsemium sempervirens*
Jessamine, yellow	*Gelsemium sempervirens*
Lespedeza	*Lespedesa* spp.
Myrtle, wax	*Myrica cerifera*
Oak, dwarf live	*Quercus minima*
Oak, poison	*Rhus toxidodendron*
Oak, runner	*Quercus pumila*
Oak, sand live	*Quercus virginiana* var. *maritima*
Oak, sand post	*Quercus stellata* var. *margaretta*
Palmetto, bush	*Sabal minor*
Palmetto, saw	*Serenoa repens*
Palmetto, scrub	*Sabal etonia*
Pea, partridge	*Cassia* spp.
Peppervine	*Ampelopsis arborea*
Privet, swamp	*Forestiera acuminata*
Ragweed	*Ambrosia* spp.
Rhyncosia	*Rhyncosia* spp.
Rosemary	*Ceratiola ericoides*
Serviceberry	*Amelanchier arborea*
Sparkleberry, tree	*Vaccinium arboreum*
Strawberry, bush	*Euonymus americanus*
Sumac, poison	*Rhus vernix*
Sumac, shining	*Rhus copallina*
Sumac, smooth	*Rhus glabra*
Susan, blackeye	*Rudbeckia hirta*
Sweetleaf, common	*Symplocos tinctoria*
Tephrosia	*Tephrosia* spp.
Tickclover	*Desmodium* spp.
Tongue, deer	*Trilisia odoratissima*
Viburnum, possumhaw	*Viburnum nudum*
Vine, rattan	*Berchemia scandens*
Walking stick, devils	*Aralia spinosa*
Willow, Virginia	*Itea virginica*
Winterberry, possumhaw	*Ilex decidua*
Yaupon	*Ilex vomitoria*

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
Grasses:	
Bluestem, broomsedge	*Andropogon virginicus*
Bluestem, creeping	*Andropogon stononiferum*
Bluestem, little	*Andropogon scoparium*
Bluestem, pinehill	*A. scoparium* var. *divergens*
Bluestem, slender	*Andropogon tener*
Dropseed, pineywoods	*Sporobolus junceus*
Grass, arrowfeather threeawn	*Aristida purpurascens*
Grass, bottlebrush threeawn	*Aristida spiciformis*
Grass, pineland threeawn	*Aristida stricta*
Panicums	*Panicum* spp.
Paspalums	*Paspalum* spp.
SOUTH CENTRAL WILDLIFE	
Mammals:	
Armadillo	*Dasypus novemcinctus*
Cottontail, eastern	*Sylvilagus floridanus*
Coyote	*Canis latrans*
Deer, white-tailed	*Odocoileus virginianus*
Ferret, black-footed	*Mustela nigripes*
Fox, gray	*Urocyon cinereoargenteus*
Gopher, plains pocket	*Geomys bursarius*
Jackrabbit, black-tailed	*Lepus californicus*
Peccary, collared	*Tayassu tajacu*
Prairie dog, black-tailed	*Cynomys ludovicianus*
Pronghorn	*Antilocapra americana*
Raccoon	*Procyon lotor*
Ringtail	*Bassariscus astutus*
Squirrel, eastern fox	*Sciurus niger*
Squirrel, Mexican ground	*Citellus mexicanus*
Squirrel, thirteen-lined ground	*Spermophilus tridecemlineatus*
Wolf, red	*Canis rufus*
Birds:	
Blackbird, red-winged	*Agelaius phoeniceus*
Bobwhite, northern	*Colinus virginianus*
Curlew, long-billed	*Numenius americanus*
Dove, mourning	*Zenaida macroura*
Duck, ruddy	*Oxyura jamaicensis*
Grebe, pied-billed	*Podilymbus podiceps*
Harrier, northern	*Circus cyaneus*
Killdeer	*Charadrius vociferus*
Kingfisher, belted	*Megaceryle alcyon*
Prairie-chicken, greater	*Tympanuchus cupido*
Quail, scaled	*Callipepla squamata*
Sandpiper, least	*Calidris minutilla*
Turkey, wild	*Meleagris gallopavo*
Warbler, golden-cheeked	*Dendroica chrysoparia*

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
Reptiles and Amphibians:	
Bullfrog	*Rana catesbeiana*
Frog, Rio Grande leopard	*Rana pipiens berlandieri*
Frog, spotted chorus	*Pseudacris clarki*
Lizard, eastern collared	*Crotaphytus collaris collaris*
Lizard, southern prairie	*Sceloporus undulatus consobrinus*
Racer, eastern yellow-bellied	*Coluber constrictor flaviventris*
Racerunner, six-lined	*Cnemidophorus sexlineatus*
Rattlesnake, western diamondback	*Crotalus atrox*
Salamander, barred tiger	*Ambystoma tigrinum mavortium*
Skink, Great Plains	*Eumeces obsoletus*
Snake, prairie ringneck	*Diadophis punctatis arnyi*
Toad, Great Plains	*Bufo cognatus*
Toad, Rocky Mountain	*Bufo woodhousei woodhousei*
Toad, Texas	*Bufo compactilis*
Turtle, snapping	*Chelydra serpentina*
Invertebrates:	
Ant, fire	*Solenopsis invicta*
Ant, carpenter	*Camponotus festinatus*
Aphid, cotton	*Aphis gossypii*
Armyworm, beet	*Spodoptera exigua*
Bee, honey	*Apis mellifera*
Beetles, lady	*Coccinella* spp.
	Hipponamia spp.
Bollworm	*Heliothis zea*
Budworm, tobacco	*Heliothis virscens*
Bugs, big-eyed	*Geocoris* spp.
Bugs, damsel	*Nabis* spp.
Butterfly, Acmon blue	*Plebejus acmon*
Butterfly, monarch	*Danaus plexippus*
Caterpillar, saltmarsh	*Estigmene acrea*
Fleahopper, cotton	*Pseudotomosculis seriatus*
Flies, hover	*Syrphus* spp.
Grasshopper, green valley	*Schistocerca shoshone*
Grasshoppers	*Schistocerca* spp.
	Trimerotropis spp.
	Melanoplus spp.
Katydid, broad-winged	*Microcentrum rhombifolium*
Lacewings, brown	*Hemerobius* spp.
Lacewings, green	*Chrysopa* spp.
Leafworm, cotton	*Alabama argillacea*
Looper, cabbage	*Tricloplosia in*
Mantis, California	*Stagmomantis california*
Mite, spotted spider	*Tetranychus urticae*
Moth, bella	*Utetheisa bella*
Moth, greasewood	*Agapema galbina*
Perforator, cottonleaf	*Bucculatrix thurberiella*
Piratebugs, minute	*Orios* spp.

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
Invertebrates (continued):	
Stinkbugs	*Nezara* spp.
Thrips	*Frankiniella* spp.
	Thrips spp.
	Sericothrips spp.
Webworm, garden	*Achyra rantalis*
Fish:	
Bass, largemouth	*Micropterus salmoides*
Bass, white	*Morone chrysops*
Bluegill	*Lepomis macrochirus*
Carp	*Cyprinus carpio*
Catfish, blue	*Ictalurus furcatus*
Catfish, channel	*Ictalurus punctatus*
Catfish, flathead	*Pylodictis olivaris*
Fish, mosquito	*Gambusia affinis*
Gar, longnose	*Lepisosteus osseus*
Minnow, roundnose	*Dionda episcopa*
Perch, yellow	*Perca flavescens*
Shad, gizzard	*Dorosoma cepedianum*
Shiner, sand	*Notropis stramineus*
Sunfish, green	*Lepomis cyanellus*
Sunfish, redbreast	*Lepomis auritus*
Tetra, Mexican	*Astyanax mexicanus*
SOUTH CENTRAL VEGETATION	
Trees:	
Cottonwood, eastern	*Populus deltoides*
Elder, box	*Acer negundo*
Elm, American	*Ulmus americana*
Hackberry	*Celtis occidentalis*
Hickory, bitternut	*Carya cordiformis*
Hickory, mockernut	*Carya tomentosa*
Juniper	*Juniperus* spp.
Oak, blackjack	*Quercus marilandica*
Oak, bur	*Quercus macrocarpa*
Oak, live	*Quercus virginiana*
Oak, post	*Quercus stellata*
Osage-orange	*Maclura pomifera*
Pecan	*Carya illinoensis*
Pine, loblolly	*Pinus taeda*
Pine, shortleaf	*Pinus echinata*
Soapberry, western	*Sapindus drummondii*
Walnut, black	*Juglans nigra*

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
Shrubs, Forbs, and Other Plants:	
Aster, white heath	*Aster ericoides*
Beautyberry, American	*Callicarpa americana*
Cockle, corn	*Agrostemma githago*
Daleas	*Dalea* spp.
Delight, heart's	*Abronia fragrans*
Greenbriers	*Smilax* spp.
Hawthorn	*Crataegus* spp.
Honeysuckle	*Lonicera* spp.
Lespedezas	*Lespedeza* spp.
Mesquite, honey	*Prosopis glandulosa*
Rose, prairie	*Rosa setigera*
Spiderwort	*Tradescantia ohiensis*
Sunflowers	*Helianthus* spp.
Thimbleweed	*Anemone cylindrica*
Tickclover	*Desmodium* spp.
Whitethorn	*Acacia neovernicosa*
Yaupon	*Ilex vomitoria*
Grasses:	
Bluegrama	*Bouteloua gracilis*
Bluestem, big	*Andropogon gerardi*
Bluestem, little	*Andropogon scoparius*
Broomsedge	*Andropogon virginicus*
Grama, sideoats	*Bouteloua curtipendula*
Grass, buffalo	*Buchloe dactyloides*
Grass, needle	*Stipa spartea*
Indiangrass	*Sorghastrum nutans*
Junegrass	*Koeleria cristata*
Rye, common	*Secale cereale*
Switchgrass	*Panicum virgatum*
SOUTHWEST WILDLIFE	
Mammals:	
Badger	*Taxidea taxus*
Bat, Brazilian free-tailed	*Tadarida brasiliensis*
Bear, black	*Ursus americanus*
Bobcat	*Lynx rufus*
Cottontail, desert	*Sylvilagus auduboni*
Coyote	*Canis latrans*
Deer, mule	*Odocoileus hemionus*
Deer, white-tailed	*Odocoileus virginianus*
Jackrabbit, black-tailed	*Lepus californicus*
Lion, mountain	*Felis concolor*
Mouse, deer	*Peromyscus maniculatus*
Myotis, California	*Myotis californicus*
Peccary, collared	*Tayassu tajacu*

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
Mammals (continued):	
Pronghorn	*Antilocapra americana*
Rats, kangaroo	
Bannertail	*Dipodomys spectabilis*
Desert	*Dipodomys deserti*
Merriam	*Dipodomys merriami*
Sheep, bighorn	*Ovis canadensis*
Birds:	
Blackbird, Brewer's	*Euphagus cyanocephalus*
Bushtit	*Psaltriparus minimus*
Eagle, golden	*Aquila chrysaetos*
Flicker, common	*Colaptes auratus*
Hawk, Cooper's	*Accipiter cooperii*
Jay, pinyon	*Gymnorhinus cyanocephalus*
Kestrel, American	*Falco sparverius*
Quail, California	*Lophortyx californica*
Quail, Gambel's	*Lophortyx gambelii*
Quail, scaled	*Callipepla squamata*
Roadrunner, greater	*Geococcyx californianus*
Shrike, loggerhead	*Lanius ludovicianus*
Sparrow, lark	*Chondestes grammacus*
Titmouse, plain	*Parus inornatus*
Verdin	*Auriparus flaviceps*
Woodpecker, Gila	*Melanerpes uropygialis*
Wren, cactus	*Campylorhynchus brunneicapillus*
Reptiles and Amphibians:	
Bullfrog	*Rana catesbeiana*
Coachwhip	*Masticophis flagellum*
Frog, Rio Grande leopard	*Rana pipiens berlandieri*
Lizard, bluntnose leopard	*Gambelia silus*
Lizard, collared	*Crotaphytus collaris*
Lizard, lesser earless	*Holbrookia maculata*
Lizard, Texas horned	*Phrynosoma cornutum*
Lizard, western whiptail	*Cnemidophorus tigris*
Monster, Gila	*Heloderma suspectum*
Rattlesnake, western diamondback	*Crotalus atrox*
Salamander, tiger	*Ambystoma tigrinum*
Skink, western	*Eumeces skiltonianus*
Snake, glossy	*Arizona elegans*
Snake, longnose	*Rhinocheilus lecontei*
Snake, pine-gopher	*Pituophis melanoleucus*
Snake, western blind	*Leptotyphlops humilis*

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
Invertebrates:	
Ant, harvester	*Pogonomyrmex barbatus*
Aphid, cotton	*Aphis gossypii*
Armyworm, beet	*Spodoptera exigua*
Bee, honey	*Apis mellifera*
Beetle, desert skunk	*Eleodes armata*
Beetles, lady	*Coccinella* spp.
	Hipponamia spp.
Bollworm	*Heliothis zea*
Bollworm, pink	*Pectinophora gossypiella*
Budworm, tobacco	*Heliothis virscens*
Bugs, big-eyed	*Geocoris* spp.
Bugs, damsel	*Nabis* spp.
Butterfly, chalcedona checkerspot	*Euphydryas chalcedona*
Butterfly, Lorquin's admiral	*Limentis lorquini*
Butterfly, sleepy orange	*Eurema nicippe*
Butterfly, western sister	*Adelpha bredowii*
Caterpillar, saltmarsh	*Estigmene acrea*
Flies, hover	*Syrphus* spp.
Grasshopper, panther spotted	*Poecilotettix pantherina*
Grasshoppers	*Schistocerca* spp.
	Trimerotropis spp.
	Melanoplus spp.
Lacewings, brown	*Hemerobius* spp.
Lacewings, green	*Chrysopa* spp.
Leafworm, cotton	*Alabama argillacea*
Looper, cabbage	*Tricloplosia in*
Moth, Barnes' tiger	*Ozadamia barnesii*
Perforator, cottonleaf	*Bucculatrix thurberiella*
Piratebugs, minute	*Orios* spp.
Scorpions, centruroides	*Centruroides* spp.
Stinkbugs	*Nezara* spp.
Tarantula, desert	*Aphonopelma chalcodes*
Thrips	*Frankiniella* spp.
	Thrips spp.
	Sericothrips spp.
Wasp, white grub	*Triscolia ardens*
Webworm, garden	*Achyra rantalis*
Fish:	
Bass, largemouth	*Micropterus salmoides*
Bullhead, black	*Ictalurus melas*
Catfish, channel	*Ictalurus punctatus*
Dace, speckled	*Rhinichthys osculus*
Fish, mosquito	*Gambusia affinis*
Minnow, fathead	*Pimephales promelas*
Perch, yellow	*Perca flavescens*
Pupfish, desert	*Cyprinodon macularius*
Shiner, golden	*Notemigonus crysoleucas*

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
Fish (continued):	
Sunfish, green	*Lepomis cyanellus*
Trout, rainbow	*Salmo gairdneri*
SOUTHWEST VEGETATION	
Trees and Cacti:	
Aspen, quaking	*Populus tremuloides*
Cactus, giant saguaro	*Cereus giganteus*
Catclaw, Gregg	*Acacia gregii*
Century plant, Parry's	*Agave paryi*
Cholla, pencil	*Opuntia ramosissima*
Cholla, tree	*Opuntia imbricata*
Juniper, Alligator	*Juniperus deppeana*
Juniper, Common	*Juniperus communis*
Juniper, Oneseed	*Juniperus monosperma*
Juniper, Utah	*Juniperus osteosperma*
Mesquite, honey	*Prosopis glandulosa*
Mesquite, velvet	*Prosopis velutina*
Oak, Arizona white	*Quercus arizonica*
Oak, blue	*Quercus douglasii*
Oak, emory	*Quercus emoryi*
Oak, gambel	*Quercus gambelii*
Oak, interior live	*Quercus wislizeni*
Oak, Mexican blue	*Quercus oblongifolia*
Oak, valley	*Quercus lobata*
Ocotillo	*Fouquieria splendens*
Pear, prickly	*Opuntia phaeacantha*
Pine, digger	*Pinus sabiniana*
Tree, Joshua	*Yucca breifolia*
Willow, desert	*Chilopsis linearis*
Shrubs, Forbs, and Other Plants:	
Buckthorns	*Rhampus* spp.
Bush, antelope	*Purshia tridentata*
Bush, creosote	*Larrea tridentata*
Ceanothus	*Ceanothus* spp.
Cliffrose	*Cowania mexicana*
Fat, winter	*Ceratoides lanata*
Mahogany, birchleaf mountain	*Cercocarpus betuloides*
Manzanitas	*Arctostaphylos* spp.
Marigold, desert	*Baileya multiradiata*
Paperflower	*Psilostrophe cooperi*
Rabbitbrush	*Chrysothammus nauseosus*

Table F-1. Common and Scientific Names of Nontarget Species (continued)

Common name	Scientific name
Shrubs, Forbs, and Other Plants (continued):	
Ratany	*Krameria parvifolia*
Sage, bur	*Ambrosia deltoidea*
Sagebrush, big	*Artemisia tridentata*
Saltbush, four-wing	*Atriplex canescens*
Tarbush	*Flourensia cernua*
Yucca, banana	*Yucca baccata*
Yucca, soaptree	*Yucca elata*
Grasses:	
Brome, California	*Bromus carinatus*
Chess, soft	*Bromus mollis*
Fescue, Arizona	*Festuca arizonica*
Fescue, foxtail	*Festuca megalura*
Galleta	*Hilaria jamesii*
Grama, black	*Bouteloua eriopoda*
Grama, blue	*Bouteloua gracilis*
Grama, sideoats	*Bouteloua curtipendula*
Junegrass	*Koeleria cristata*
Muhly, Mountain	*Muhlenbergia montana*
Oat, wild	*Avena fatua*
Ricegrass, Indian	*Oryzopsis hymenoides*
Sacaton, alkali	*Sporobolus airoides*
Wheatgrass, western	*Agropyron smithii*
AQUATIC INVERTEBRATES—ALL PROGRAM AREAS	*Order*
Beetles, crawling water	Coleoptera
Beetles, whirligig	Coleoptera
Bugs, giant water	Hemiptera
Clams	Schizodonta
Crayfish	Decapoda
Dragonflies	Odonata
Leeches	Gnathobdellida
Limpets	Puomonata
Mayflies	Ephemeroptera
Mussels	Schizodonta
Scorpions, water	Hemiptera
Shrimp	Decapoda
Snails	Puomonata
Stoneflies	Plecoptera
Worms, horsehair	Nematomorpha (phyllum)

Appendix G

State-Designated Endangered, Threatened, and Proposed Species

Overview

This appendix contains tables that list the endangered, threatened, and proposed species found in States where the boll weevil control program would be conducted.

Tables G-1 through G-16 contain a list of each Cotton Belt State's own designation of rare species found within its boundaries (as of 1989, unless indicated in footnotes). North Carolina has not designated any species as endangered or threatened. Candidate species for State listing are not included. Species listed may be within, near, or distant from control program areas.

Abbreviations Used in the Tables

Abbreviations used in the tables in the "Status" column are defined as follows:

E = Endangered species: any species in danger of disappearing from all or a significant portion of its range that is within State boundaries.

T = Threatened species: any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range that lies within State boundaries.

SC = Special concern: may become endangered or threatened in the foreseeable future.

P = Poorly known, data lacking.

R = Rare.

SSC = Species of special concern.

U = Unusual, therefore of special concern.

T (S/A) = Threatened species listed because of similarity of appearance to another listed species.

S = Special concern.

E-P = Endangered and possibly extirpated; has not been recently observed.

S-P = Special concern and possibly extirpated; has not been recently observed.

Table G-1. State-Designated Endangered and Threatened Species—Alabama

Common name	Scientific name	Status
Mammals:		
Bat*, Brazilian free-tailed	*Tadarida brasiliensis*	SC
Bat*, gray	*Myotis grisescens*	E
Bat*, Indiana	*Myotis sodalis*	E
Bat, northern yellow	*Lasiurus intermedius*	P
Bat*, Rafinesque's big-eared	*Plecotus rafinesquii*	SC
Bat*, southeastern	*Myotis austroriparius*	SC
Bear, black	*Ursus americanus*	SC
Cottontail, New England	*Sylvilagus transitionalis*	P
Gopher*, southeastern pocket	*Geomys pinetis*	SC
Jaguarundi	*Felis yugouaroundi cacomitli*	P
Lion, mountain	*Felis concolor*	E
Mouse*, Alabama beach	*Peromyscus polionotus ammobates*	E
Mouse*, meadow jumping	*Zapus hudsonius*	SC
Mouse*, Perdido Key beach	*Peromyscus polionotus trissyllepsis*	E
Rabbit, marsh	*Sylvilagus palustris*	P
Birds:		
Crane*, Mississippi sandhill	*Grus canadensis pulla*	E
Dove*, common ground	*Columbina passerina*	SC
Duck, mottled	*Anas fulvigula*	SC
Eagle*, bald	*Haliaeetus leucocephalus*	E
Eagle*, golden	*Aguila chrysaetos*	T
Egret*, reddish	*Egretta rufuscens*	SC
Falcon*, peregrine	*Falco peregrinus*	T
Flycatcher, alder	*Empidonax alnorum*	P
Flycatcher, willow	*Empidonax traillii*	P
Hawk*, Cooper's	*Accipiter cooperii*	SC
Merlin*	*Falco columbarius*	SC
Osprey*	*Pandion haliaetus*	SC
Owl, long-eared	*Asio otus*	P
Owl, northern saw-whet	*Aegolius acadicus*	P
Oystercatcher*, American	*Haematopus palliatus*	SC
Pelican*, American white	*Pelecanus erythrorhynchos*	SC
Plover*, piping	*Charadrius melodus*	SC
Plover*, snowy	*Charadrius alexandrinus*	E

Table G-1. State-Designated Endangered and Threatened Species—Alabama (continued)

Common name	Scientific name	Status
Birds (continued):		
Plover*, Wilson's	*Charadrius wilsonia*	SC
Rail, black	*Laterallus jamaicensis*	P
Rail, yellow	*Coturnicops noveboracensis*	P
Sparrow, Henslow's	*Ammodramus henslowii*	P
Sparrow, Le Conte's	*Ammodramus leconteii*	P
Stork*, wood	*Mycteria americana linnaeus*	E
Tern*, gull-billed	*Sterna nilotica*	SC
Vireo, warbling	*Vireo gilvus*	P
Warbler*, Bachman's	*Vermivora bachmanii*	E
Woodpecker*, red-cockaded	*Picoides (=Dendrocopus) borealis*	E
Wren*, Bewick's	*Thryomanes bewickii*	T
Reptiles:		
Snakes—		
Coachwhip*, eastern	*Masticophis flagellum flagellum*	SC
Rattlesnake, eastern diamondback	*Crotalus adamanteus*	SC
Snake*, black pine	*Pituophis melanoleucus lodingi*	T
Snake*, eastern indigo	*Drymarchon corais couperi*	E
Snake, eastern milk	*Lampropeltis triangulum triangulum*	P
Snake*, Florida pine	*Pituophis melanoleucus mugitus*	T
Snake*, Gulf salt marsh	*Nerodia fasciata clarki*	SC
Snake, northern pine	*Pituophis melanoleucus melanoleucus*	P
Snake, pine woods	*Rhadinaea flavilata*	P
Snake, rainbow	*Farancia erytrogramma erytrogramma*	P
Snake, red milk	*Lampropeltis triangulum syspila*	P
Snake*, southern hognose	*Heterodon simus*	T
Turtles—		
Terrapin*, Mississippi diamondback	*Malaclemys terrapin pileata*	P
Tortoise, gopher	*Gopherus polyphemus*	T
Turtle*, Alabama map	*Graptemys pulchra*	SC
Turtle*, Alabama red-bellied	*Pseudemys alabamensis*	T

Table G-1. State-Designated Endangered and Threatened Species—Alabama (continued)

Common name	Scientific name	Status
Reptiles (continued):		
Turtle*, alligator snapping	*Macroclemys temmincki*	SC
Turtle, Atlantic green	*Chelonia mydas mydas*	E
Turtle, Atlantic leatherback	*Dermochelys coriacea coriacea*	E
Turtle, Atlantic loggerhead	*Caretta caretta caretta*	E
Turtle, Atlantic ridley	*Lepidochelys kempii*	E
Turtle*, Barbour's map	*Graptemys barbouri*	T
Turtle*, box	*Terrapene carolina*	SC
Turtle**, flattened musk	*Sternotherus depressus*	T
Lizards—		
Alligator, American	*Alligator mississippiensis*	SC
Skink, coal	*Eumeces anthracinus*	P
Amphibians:		
Salamanders—		
Amphiuma, one-toed	*Amphiuma pholeter*	P
Hellbender*, eastern	*Cryptobranchus alleganiensis alleganiensis*	T
Salamander, eastern tiger	*Ambystoma tigrinum tigrinum*	P
Salamander*, flatwoods	*Ambystoma cingulatum*	SC
Salamander*, green	*Aneides aeneus*	P
Salamander, Gulf Coast mud	*Pseudotriton montanus flavissimus*	P
Salamander, mountain dusky	*Desmognathus ochrophaeus*	P
Salamander*, Red Hills	*Phaeognathus hubrichti*	T
Salamander*, seal	*Desmognathus monticola* (of Coastal Plain origin)	SC
Salamander, small-mouthed	*Ambystoma texanum*	P
Salamander, southern dusky	*Desmognathus auriculatus*	P
Salamander, southern red	*Pseudotriton ruber vioscai*	P
Salamander*, Tennessee cave	*Gyrinophilus palleucus*	P
Siren, greater	*Siren lacertina*	P
Waterdog, Black Warrior	*Necturus* sp.	P

Table G-1. State-Designated Endangered and Threatened Species—Alabama (continued)

Common name	Scientific name	Status
Amphibians (continued):		
Frogs and toads—		
Frog*, dusky gopher	*Rana areolata sevosa*	T
Treefrog*, pine barrens	*Hyla andersonii*	T
Fish:		
Cavefish*, Alabama	*Speoplatyrhinus poulsoni*	E
Cavefish*, southern	*Typhlichthys subterraneus*	SC
Chub, spotfin	*Cyprinella (=Hybopsis) monacha*	P
Darter*, coldwater	*Etheostoma ditrema*	SC
Darter*, crystal	*Ammocrypta asprella*	SC
Darter*, goldline	*Percina aurolineata*	T
Darter*, slackwater	*Etheostoma boschungi*	T
Darter*, snail	*Percina tanasi*	T
Darter, trispot	*Etheostoma trisella*	P
Darter*, Tuscumbia	*Etheostoma tuscumbia*	SC
Darter*, watercress	*Etheostoma nuchale*	E
Madtom*, frecklebelly	*Noturus munitus*	SC
Pygmy*, sculpin	*Cottus pygmaeus*	T
Shiner*, blue	*Notropis caeruleus*	SC
Shiner*, Cahaba	*Notropis* sp. cf. *volucellus*	E
Shiner*, paleband	*Notropis* sp. cf. *procne*	T
Sturgeon, Alabama shovelnose	*Scaphirhynchus* sp. cf. *platorynchus*	P

* Denotes those species protected by Alabama's Nongame Species Regulation 1987; ** indicates protected by State law.

Note: Status obtained from *Vertebrate Animals of Alabama in Need of Special Attention 1986.*

Table G-2. State-Designated Endangered and Threatened Species—Arizona

Common name	Scientific name	Status
Mammals:		
Bat, Mexican long-tongued	*Choeronycteris mexicana*	T
Bat, Sanborn's long-nosed	*Leptonycteris sanborni (=yerbabuenae)*	E
Bear, grizzly	*Ursus arctos* (=u.a. *horribilis*)	E
Ferret, black-footed	*Mustela nigripes*	E
Jaguar	*Felis onca*	E
Mouse, meadow jumping	*Zapus hudsonius*	T
Ocelot	*Felis pardalis*	E
Otter, southwestern river	*Lutra canadensis sonora*	E
Prairie dog, black-tailed	*Cynomys ludovicianus*	E
Pronghorn, Chihuahuan	*Antilocapra americana mexicana*	T
Pronghorn, Sonoran	*Antilocapra americana sonoriensis*	E
Puma, Yuma	*Felis concolor browni*	E
Rat, New Mexican banner-tailed kangaroo	*Dipodomys spectabilis baileyi*	E
Shrew, water	*Sorex palustris*	E
Squirrel, Mount Graham red	*Tamiasciurus hudsonicus grahamensis*	E
Vole, Hualapai Mexican	*Microtus mexicanus hualpaiensis*	E
Vole, Navajo Mexican	*Microtus mexicanus navaho*	T
Wolf, Mexican gray	*Canis lupus baileyi*	E
Birds:		
Bobolink	*Dolichonyx oryzivorus*	E
Bobwhite, masked	*Colinus virginianus ridgwayi*	E
Catbird, gray	*Dumetella carolinensis*	T
Condor, California	*Gymnogyps californianus*	E
Cuckoo, yellow-billed	*Coccyzus americanus*	T
Eagle, bald	*Haliaeetus leucocephalus*	E
Egret, great	*Casmerodius albus*	E
Egret, snowy	*Egretta thula*	T
Falcon, northern aplomado	*Falco femoralis septentrionalis*	E
Flycatcher, buff-breasted	*Empidonax fulvifrons*	E
Flycatcher, willow	*Empidonax traillii*	E
Hawk, ferruginous	*Buteo regalis*	T
Hawk, gray	*Buteo nitidus*	T
Osprey	*Pandion haliaetus*	T
Owl, spotted	*Strix occidentalis*	T
Parrot, thick-billed	*Rhynchopsitta pachyrhyncha*	E

Table G-2. State-Designated Endangered and Threatened Species—Arizona (continued)

Common name	Scientific name	Status
Birds (continued):		
Pygmy-owl, ferruginous	*Glaucidium brasilianum*	E
Rail, black	*Laterallus jamaicensis*	E
Rail, Yuma clapper	*Rallus longirostris yumanensis*	T
Redstart, American	*Setophaga ruticilla*	T
Sparrow, Baird's	*Ammodramus bairdii*	T
Veery	*Catharus fuscescens*	T
Reptiles:		
Snakes—		
Massasauga	*Sistrurus catenatus*	E
Lizards—		
Lizard, flat-tailed horned	*Phrynosoma mcallii*	T
Skink, Arizona	*Eumeces gilberti arizonensis*	E
Amphibians:		
Salamanders—		
Salamander, Huachuca tiger	*Ambystoma tigrinum stebbinsi*	E
Frogs and toads—		
Frog, barking	*Hylactophryne augusti*	E
Frog, Chiricahua leopard	*Rana chiricahuensis*	T
Frog, plains leopard	*Rana blairi*	E
Frog, Tarahumara	*Rana tarahumarae*	E
Fish:		
Catfish, Yaqui	*Ictalurus pricei*	E
Chub, bonytail	*Gila elegans*	E
Chub, Colorado roundtail	*Gila robusta robusta*	T
Chub, Gila	*Gila intermedia*	T
Chub, humpback	*Gila cypha*	E
Chub, Sonora	*Gila ditaenia*	E
Chub, Virgin River	*Gila robusta seminuda*	E
Chub, Yaqui	*Gila purpurea*	E

Table G-2. State-Designated Endangered and Threatened Species—Arizona (continued)

Common name	Scientific name	Status
Fish (continued):		
Minnow, loach	*Tiaroga cobitis*	T
Pupfish, desert	*Cyprinodon macularius*	E
Pupfish, Quitobaquito	*Cyprinodon macularius eremus*	E
Shiner, Yaqui	*Notropis formosus mearnsi*	E
Spikedace	*Meda fulgida*	T
Spinedace, Little Colorado	*Lepidomeda vittata*	T
Spinedace, Virgin	*Lepidomeda mollispinis mollispinis*	E
Squawfish, Colorado	*Ptychocheilus lucius*	E
Stoneroller, Arizona	*Campostoma ornatum pricei*	E
Sucker, razorback	*Xyrauchen texanus*	E
Sucker, Yaqui	*Catostomus bernardini*	E
Topminnow, Gila	*Poeciliopsis occidentalis occidentalis*	T
Topminnow, Yaqui	*Poeciliopsis occidentalis sonoriensis*	E
Trout, Apache	*Oncorhynchus (=Salmo) apache*	T
Trout, Gila	*Oncorhynchus (=Salmo) gilae*	E
Woundfin	*Plagopterus argentissimus*	E

Table G-3. State-Designated Endangered and Threatened Species—Arkansas

Common name	Scientific name	Status
Plants:		
Amorpha	*Amorpha paniculata*	T
Aster, forked	*Aster furcatus*	T
Aster	*Aster pratensis*	T
Bay, red	*Persea borbonia*	E[a]
Camellia, silky	*Stewartia malachodendron*	E
Catchfly, ovate-leaf	*Silene ovata*	T
Catchfly, royal	*Silene regia*	T
Cherry, sand-	*Prunus pumila*	T
Cinquefoil, tall	*Potentilla arguta*	T
Clover, little-leaved prairie	*Dalea phleoides* var. *microphylla*	T
Clover, prairie-	*Dalea villosa* var. *grisea*	E
Coneflower, yellow	*Echinacea paradoxa*	T
Dropseed, pineywoods	*Sporobolus junceus*	T
Dropseed, whorled	*Sporobolus pyramidatus*	T
Echinacea	*Echinacea sanguinea*	T
Evolvulus	*Evolvulus sericeus*	T
Fern, filmy	*Trichomanes boschianum*	T
Fern, interrupted	*Osmunda claytoniana*	T
Fern, dwarf	*Trichomanes petersii*	T
Fern, spinulose shield	*Dryopteris spinulosa*	T
Flower, twist	*Streptanthus hyacinthoides*	T
Flower, twist	*Streptanthus squamiformis*	T
Gamma, hairy	*Bouteloua hirsuta*	E
Gentian, rose	*Sabatia campanulata*	E[a]
Geocarpon	*Geocarpon minimum*	E
Goldenrod, Riddell's	*Solidago riddellii*	T
Grama, Texas	*Bouteloua rigidiseta*	E
Grass, Ofer Hollow reed	*Calamagrostis insperata*	E
Grass, white-topped umbrella	*Rhynchospora colorata*	E
Grass, Whitlow	*Draba aprica*	T
Grass, yellow-eyed	*Xyris baldwiniana*	T
Hickory, sand	*Carya pallida*	T
Lady-slipper, showy	*Cypripedium reginae*	E
Magnolia, bigleaf	*Magnolia macrophylla*	E
Matelea, climbing	*Matelea cynanchoides*	E
Oak, Durand's	*Quercus durandii*	T

Table G-3. State-Designated Endangered and Threatened Species—Arkansas (continued)

Common Name	Scientific name	Status
Plants (continued):		
Oak, maple leaf	*Quercus shumardii* var. *acerifolia*	T
Orchid, pale green	*Platanthera flava*	T
Orchid, purple fringeless	*Platanthera peramoena*	T
Orchid, snake-mouth	*Pogonia ophioglossoides*	T
Orchid, snowy	*Platanthera nivea*	E[b]
Pea, scarlet	*Indigofera miniata* var. *leptosepala*	T
Penstemon, scarlet	*Penstemon murrayanus*	T
Pipewort, small-headed	*Eriocaulon kornickianum*	E
Plantain, heart-leaf	*Plantago cordata*	T
Pondberry	*Lindera melissifolia*	E
Primrose, evening-	*Oenothera pilosella* ssp. *sessilis*	T
Psoralea	*Psoralea digitata*	T
Psoralea	*Psoralea subulata*	E
Ray, nerve	*Tetragonotheca ludoviciana*	E
Rue, Arkansas meadow	*Thalictrum arkansanum*	T
Rush, beak-	*Rhynchospora rariflora*	T
Scleria	*Scleria verticillata*	T
Sedge	*Carex bicknelli* var. *opaca*	E
Sedge, waterfall's	*Carex latebracteata*	T
Skullcap	*Scutellaria bushii*	T
Star, French's shooting	*Dodecatheon frenchii*	T
Stenosiphon	*Stenosiphon virgatus*	T
Sunnybell, Texas	*Schoenolirion wrightii*	T
Thistle, swamp	*Cirsium muticum*	T
Tree, snow-drop	*Halesia diptera*	E[a]
Turtlehead, rose	*Chelone obliqua* var. *speciosa*	E[a]
Twayblade, Loesel's	*Liparis loeselii*	T
Willow, silky	*Salix sericea*	E[a]
Winterberry	*Ilex verticillata*	T
Wreath, snow	*Neviusia alabamensis*	T

[a] Taxon may be extirpated from Arkansas.
[b] Species protected by Arkansas' Nongame Species Regulation 1987.

Note: There is no State list of endangered wildlife.

Table G-4. State-Designated Endangered and Threatened Species—California

Common name	Scientific name	Status
Mammals:		
Fox, island	*Urocyon littoralis*	T
Fox, San Joaquin kit	*Vulpes macrotis mutica*	T
Fox, Sierra Nevada red	*Vulpes vulpes necator*	T
Mouse, salt-marsh harvest	*Reithrodontomys raviventris*	E
Rat, Fresno kangaroo	*Dipodomys nitratoides exilis*	E
Rat, giant kangaroo	*Dipodomys ingens*	E
Rat, Morro Bay kangaroo	*Dipodomys heermanni morroensis*	E
Rat, Stephens' kangaroo	*Dipodomys stephensi*	T
Seal, Guadalupe fur	*Arctocephalus townsendi*	T
Sheep, California bighorn	*Ovis canadensis californiana*	T
Sheep, peninsular bighorn	*Ovis canadensis cremnobates*	T
Squirrel, Mohave ground	*Spermophilus mohavensis*	T
Squirrel, San Joaquin antelope	*Ammospermophilus nelsoni*	T
Vole, Amargosa	*Microtus californicus scirpensis*	E
Wolverine	*Gulo gulo*	T
Birds:		
Condor, California	*Gymnogyps californianus*	E
Crane, greater sandhill	*Grus canadensis tabida*	T
Cuckoo, western yellow-billed	*Coccyzus americanus occidentalis*	E
Eagle, bald	*Haliaeetus leucocephalus*	E
Falcon, American peregrine	*Falco peregrinus anatum*	E
Flicker, gilded northern	*Colaptes auratus chrysoides*	E
Hawk, Swainson's	*Buteo swainsoni*	T
Owl, elf	*Micrathene whitneyi*	E
Owl, great gray	*Strix nebulosa*	E
Pelican, California brown	*Pelecanus occidentalis californicus*	E
Rail, California black	*Laterallus jamaicensis coturniculus*	T
Rail, California clapper	*Rallus longirostris obsoletus*	E
Rail, light-footed clapper	*Rallus longirostris levipes*	E
Rail, Yuma clapper	*Rallus longirostris yumanensis*	T
Sparrow, Belding's savannah	*Passerculus sandwichensis beldingi*	E
Tern, California least	*Sterna antillarum (=albifrons) browni*	E
Towhee, Inyo brown	*Pipilo crissalis (=fuscus) eremophilus*	E
Vireo, Arizona Bell's	*Vireo bellii arizonae*	E

Table G-4. State-Designated Endangered and Threatened Species—California (continued)

Common name	Scientific name	Status
Birds (continued):		
Vireo, least Bell's	*Vireo bellii pusillus*	E
Woodpecker, Gila	*Melanerpes uropygialis*	E
Reptiles:		
Snakes—		
Boa, southern rubber	*Charina bottae umbratica*	T
Snake, giant garter	*Thamnophis couchi gigas*	T
Snake, San Francisco garter	*Thamnophis sirtalis tetrataenia*	E
Whipsnake, Alameda	*Masticophis lateralis euryxanthus*	T
Lizards—		
Gecko, barefoot banded	*Coleonyx switaki*	T
Lizard, blunt-nosed leopard	*Gambelia silus*	E
Lizard, Coachella Valley fringe-toed	*Uma inornata*	E
Amphibians:		
Salamanders—		
Salamander, desert slender	*Batrachoseps aridus*	E
Salamander, Kern Canyon slender	*Batrachoseps simatus*	T
Salamander, limestone	*Hydromantes brunus*	T
Salamander, Santa Cruz long-toed	*Ambystoma macrodactylum croceum*	E
Salamander, Shasta	*Hydromantes shastae*	T
Salamander, Siskiyou Mountain	*Plethodon stormi*	T
Salamander, Tehachapi slender	*Batrachoseps stebbinsi*	T
Frogs and toads—		
Toad, black	*Bufo exsul*	T
Fish:		
Chub, bonytail	*Gila elegans*	E
Chub, Mohave tui	*Gila bicolor mohavensis*	E
Chub, Owens tui	*Gila bicolor snyderi*	E
Pupfish, cottonball marsh	*Cyprinodon salinus milleri*	T
Pupfish, desert	*Cyprinodon macularius*	E
Pupfish, Owens	*Cyprinodon radiosus*	E

Table G-4. State-Designated Endangered and Threatened Species—California (continued)

Common name	Scientific name	Status
Fish (continued):		
Sculpin, rough	*Cottus asperrimus*	T
Squawfish, Colorado	*Ptychocheilus lucius*	E
Stickleback, unarmored threespine	*Gasterosteus aculeatus williamsoni*	E
Sucker, Lost River	*Deltistes luxatus*	E
Sucker, Modoc	*Catostomus microps*	E
Sucker, razorback	*Xyrauchen texanus*	E
Sucker, short-nose	*Chasmistes brevirostris*	E
Trout, bull	*Salvelinus confluentus*	E
Mollusks:		
Snail, Trinity bristle	*Monadenia setosa*	T
Crustaceans:		
Crayfish, Shasta	*Pacifastacus fortis*	E
Shrimp, California freshwater	*Syncaris pacifica*	E
Plants:		
Amole, Camatta Canyon	*Chlorogalum purpureum* var. *reductum*	R
Aster, Laguna Mountains	*Machaeranthera lagunensis*	R
Baccharis, Encinitas	*Baccharis vanessae*	E
Barberry, island	*Mahonia pinnata* ssp. *insularis*	E
Barberry, Nevin's	*Mahonia nevinii*	E
Barberry, Truckee	*Mahonia sonnei*	E
Bedstraw, Borrego	*Galium angustifolium* ssp. *borregoense*	R
Bedstraw, box	*Galium buxifolium*	R
Bedstraw, El Dorado	*Galium californicum* ssp. *sierrae*	R
Bedstraw, San Clemente Island	*Galium catalinense* ssp. *acrispum*	E
Bensoniella	*Bensoniella oregona*	R
Bird's-beak, Ferris'	*Cordylanthus palmatus*	E
Bird's-beak, Mt. Diablo	*Cordylanthus nidularius*	R
Bird's-beak, Pennell's	*Cordylanthus tenuis* ssp. *capillaris*	R
Bird's-beak, salt marsh	*Cordylanthus maritimus* ssp. *maritimus*	E
Bird's-beak, seaside	*Cordylanthus rigidus* ssp. *littoralis*	E
Bird's-beak, soft	*Cordylanthus mollis* ssp. *mollis*	R
Blennosperma, Point Reyes	*Blennosperma nanum* var. *robustum*	R

Table G-4. State-Designated Endangered and Threatened Species—California (continued)

Common name	Scientific name	Status
Plants (continued):		
Brodiaea, Chinese Camp	*Brodiaea pallida*	E
Brodiaea, Indian Valley	*Brodiaea coronaria* ssp. *rosea*	E
Brodiaea, Kaweah	*Brodiaea insignis*	E
Brodiaea, thread-leaved	*Brodiaea filifolia*	E
Broom, San Clemente Island	*Lotus dendroideus* var. *traskiae*	E
Buckwheat, Butterworth's	*Eriogonum butterworthianum*	R
Buckwheat, Conejo	*Eriogonum crocatum*	R
Buckwheat, Ione	*Eriogonum apricum* var. *apricum*	E
Buckwheat, Irish hill	*Eriogonum apricum* var. *prostratum*	E
Buckwheat, Kellogg's	*Eriogonum kelloggii*	E
Buckwheat, San Nicolas Island	*Eriogonum grande* ssp. *timorum*	E
Buckwheat, Santa Barbara Island	*Eriogonum giganteum* var. *compactum*	R
Buckwheat, Thorne's	*Eriogonum ericifolium* var. *thornei*	E
Buckwheat, Trinity	*Eriogonum alpinum*	E
Buckwheat, Twisselmann's	*Eriogonum twisselmannii*	R
Butterweed, Gander's	*Senecio ganderi*	R
Butterweed, Layne's	*Senecio layneae*	R
Catchfly, Red Mountain	*Silene campanulata* ssp. *campanulata*	E
Ceanothus, Hearst's	*Ceanothus hearstiorum*	R
Ceanothus, maritime	*Ceanothus maritimus*	R
Ceanothus, Mason's	*Ceanothus masonii*	R
Ceanothus, Pine Hill	*Ceanothus roderickii*	R
Celery, Delta button	*Eryngium racemosum*	E
Celery, Loch Lomond button	*Eryngium constancei*	E
Celery, San Diego button	*Eryngium aristulatum* var. *parishii*	E
Checkerbloom, bird-footed	*Sidalcea pedata*	E
Checkerbloom, Cuesta Pass	*Sidalcea hickmanii* ssp. *anomala*	R
Checkerbloom, Kenwood Marsh	*Sidalcea oregana* ssp. *valida*	E
Checkerbloom, Owens Valley	*Sidalcea covillei*	E
Checkerbloom, Parish's	*Sidalcea hickmanii* ssp. *parishii*	R
Checkerbloom, Scadden flat	*Sidalcea stipularis*	E
Cinquefoil, Hickman's	*Potentilla hickmanii*	E
Clarkia, Merced	*Clarkia lingulata*	E
Clarkia, Pismo	*Clarkia speciosa* ssp. *immaculata*	R
Clarkia, Presidio	*Clarkia franciscana*	E

Table G-4. State-Designated Endangered and Threatened Species—California (continued)

Common name	Scientific name	Status
Plants (continued):		
Clarkia, Springville	*Clarkia springvillensis*	E
Clarkia, Vine Hill	*Clarkia imbricata*	E
Clover, Monterey	*Trifolium trichocalyx*	E
Clover, Pacific Grove	*Trifolium polyodon*	R
Cress, McDonald's rock	*Arabis macdonaldiana*	E
Cress, Tahoe yellow	*Rorippa subumbellata*	E
Croton, Wiggins'	*Croton wigginsii*	R
Cryptantha, bristlecone	*Cryptantha roosiorum*	R
Cypress, Santa Cruz	*Cupressus abramsiana*	E
Downingia, Cuyamaca Lake	*Downingia concolor* var. *brevior*	E
Dudleya, Laguna Beach	*Dudleya stolonifera*	T
Dudleya, Santa Barbara Island	*Dudleya traskiae*	E
Dudleya, Santa Cruz Island	*Dudleya nesiotica*	R
Dudleya, Santa Monica Mountains	*Dudleya cymosa* ssp. *marcescens*	R
Dudleya, short-leaved	*Dudleya brevifolia*	E
Elisens, Coville & C. Morton	*Maurandya petrophila (Holmgrenaanthe)*	R
Eriastrum, Tracy's	*Eriastrum tracyi*	R
Evening-primrose, Antioch Dunes	*Oenothera deltoides* ssp. *howellii*	E
Evening-primrose, Eureka Valley	*Oenothera avita* ssp. *eurekensis*	R
False-lupine, Santa Ynez	*Thermopsis macrophylla* var. *agnina*	R
Fiddleneck, large-flowered	*Amsinckia grandiflora*	E
Flannelbush, Mexican	*Fremontodendron mexicanum*	R
Flannelbush, Pine Hill	*Fremontodendron decumbens*	R
Flax, Lake County dwarf foot	*Hesperolinon didymocarpum*	E
Fritillary, Roderick's	*Fritillaria roderickii*	E
Gilia, sand	*Gilia tenuiflora* ssp. *arenaria*	T
Gold, July	*Dedeckera eurekensis*	R
Goldenstar, dwarf	*Bloomeria humilis*	R
Goldfields, Burke's	*Lasthenia burkei*	E
Grass, California orcutt	*Orcuttia californica*	E
Grass, colusa	*Neostapfia colusana*	E
Grass, Eureka Valley dune	*Swallenia alexandrae*	R
Grass, hairy orcutt	*Orcuttia pilosa*	E
Grass, leafy reed	*Calamagrostis foliosa*	R
Grass, Marin bent	*Agrostis blasdalei* var. *marinensis*	R

Table G-4. State-Designated Endangered and Threatened Species—California (continued)

Common name	Scientific name	Status
Plants (continued):		
Grass, Napa blue	*Poa napensis*	E
Grass, North Coast semaphore	*Pleuropogon hooverianus*	R
Grass, Sacramento orcutt	*Orcuttia viscida*	E
Grass, San Joaquin Valley orcutt	*Orcuttia inaequalis*	E
Grass, slender orcutt	*Orcuttia tenuis*	E
Hedge-hyssop, Boggs Lake Island	*Gratiola heterosepala*	E
Ivesia, Tahquitz	*Ivesia callida*	R
Jewelflower, California	*Caulanthus californicus*	E
Jewelflower, slender-pod	*Caulanthus stenocarpus*	R
Larkspur, Baker's	*Delphinium bakeri*	R
Larkspur, Cuyamaca	*Delphinium hesperium* ssp. *cuyamacae*	R
Larkspur, San Clemente Island	*Delphinium kinkiense*	E
Larkspur, yellow	*Delphinium luteum*	R
Lewisia, Congdon's	*Lewisia congdonii*	R
Lilaeopsis, Mason's	*Lilaeopsis masonii*	R
Lilly, striped adobe	*Fritillaria striata*	T
Lily, Dunn's mariposa	*Calochortus dunnii*	R
Lily, Pitkin marsh	*Lilium pitkinense*	E
Lily, Siskiyou mariposa	*Calochortus persistens*	R
Lily, Tiburon mariposa	*Calochortus tiburonensis*	T
Lily, western	*Lilium occidentale*	E
Lousewort, Dudley's	*Pedicularis dudleyi*	R
Lupine, Father Crowley's	*Lupinus padre-crowleyi*	R
Lupine, Milo Baker's	*Lupinus milo-bakeri*	T
Lupine, Nipomo mesa	*Lupinus nipomensis*	E
Lupine, Tidestrom's	*Lupinus tidestromii* var. *tidestromii*	E
Mallow, San Clemente Island bush	*Malacothamnus clementinus*	E
Mallow, Santa Cruz Island bush	*Malacothamnus fasciculatus* var. nesioticus	E
Manzanita, Alameda	*Arctostaphylos pallida*	E
Manzanita, Baker's	*Arctostaphylos bakeri*	R
Manzanita, hanging gardens	*Arctostaphylos edmundsii* var. *parvifolia*	R
Manzanita, Hearst's	*Arctostaphylos hookeri* ssp. *hearstiorum*	E
Manzanita, Pacific	*Arctostaphylos pacifica*	E
Manzanita, Presidio	*Arctostaphylos hookeri* ssp. *ravenii*	E

Table G-4. State-Designated Endangered and Threatened Species—California (continued)

Common name	Scientific name	Status
Plants (continued):		
Manzanita, San Bruno Mountain	*Arctostaphylos imbricata*	E
Manzanita, Vine Hill	*Arctostaphylos densiflora*	E
Meadowfoam, Baker's	*Limnanthes bakeri*	R
Meadowfoam, Parish's	*Limnanthes gracilis* var. *parishii*	E
Meadowfoam, Point Reyes	*Limnanthes douglasii* var. *sulphurea*	E
Meadowfoam, Sebastopol	*Limnanthes vinculans*	E
Meadowfoam, Shippee	*Limnanthes floccosa* ssp. *californica*	E
Milk-vetch, coastal dunes	*Astragalus tener* var. *titi*	E
Milk-vetch, Humboldt	*Astragalus agnicidus*	E
Milk-vetch, Long Valley	*Astragalus johannis-howellii*	R
Milk-vetch, Mono	*Astragalus monoensis*	R
Milk-vetch, Peirson's	*Astragalus magdalenae* var. *peirsonii*	E
Milk-vetch, Sodaville	*Astragalus lentiginosus* var. *sesquimetralis*	E
Milk-vetch, Trask's	*Astragalus traskiae*	R
Mint, Otay mesa	*Pogogyne nudiuscula*	E
Mint, San Diego mesa	*Pogogyne abramsii*	E
Mint, San Diego thorn	*Acanthomintha ilicifolia*	E
Mint, San Mateo thorn	*Acanthomintha obovata* ssp. *duttonii*	E
Mint, Santa Lucia	*Pogogyne clareana*	E
Monardella, willowy	*Monardella linoides* ssp. *viminea*	E
Morning-glory, Stebbins'	*Calystegia stebbinsii*	E
Mountain-mahogany, Santa Catalina Island	*Cercocarpus traskiae*	E
Mountainbalm, Indian knob	*Eriodictyon altissimum*	E
Navarretia, many-flowered	*Navarretia plieantha*	E
Nemacladus, Twisselmann's	*Nemacladus twisselmannii*	R
Nitrophila, Amargosa	*Nitrophila mohavensis*	E
Nolina, Dehesa	*Nolina interrata*	E
Onion, Yosemite	*Allium yosemitense*	R
Owl's-clover, succulent	*Orthocarpus campestris* var. *succulentus*	E
Paintbrush, Mt. Gleason Indian	*Castilleja gleasonii*	R
Paintbrush, Pitkin Marsh Indian	*Castilleja uliginosa*	E
Paintbrush, San Clemente Island Indian	*Castilleja grisea*	E
Panicum, Geysers'	*Dichanthelium lanuginosum* var. *thermale*	E
Phlox, Yreka	*Phlox hirsuta*	E

Table G-4. State-Designated Endangered and Threatened Species—California (continued)

Common name	Scientific name	Status
Plants (continued):		
Popcornflower, San Francisco	*Plagiobothrys diffusus*	E
Pseudobahia, Hartweg's	*Pseudobahia bahiifolia*	E
Pseudobahia, Tulare	*Pseudobahia peirsonii*	E
Saltbush, Bakersfield	*Atriplex tularensis*	E
Sanicle, adobe	*Sanicula maritima*	R
Sanicle, rock	*Sanicula saxatilis*	R
Santa, Lompoc Yuerba	*Eriodictyon capitatum*	R
Sedge, Tompkins'	*Carex tompkinsii*	R
Sedge, white	*Carex albida*	E
Spineflower, Howell's	*Chorizanthe howellii*	T
Spineflower, Orcutt's	*Chorizanthe orcuttiana*	E
Spineflower, slender-horned	*Centrostegia leptoceras*	E
Star, San Clemente Island woodland	*Lithophragma maximum*	E
Sunflower, Algodones Dunes	*Helianthus niveus* ssp. *tephrodes*	E
Sunflower, Congdon's woolly	*Eriophyllum congdonii*	R
Tarplant, Mohave	*Hemizonia mohavensis*	E
Tarplant, Otay	*Hemizonia conjugens*	E
Tarplant, red rock	*Hemizonia arida*	R
Tarplant, Santa Cruz	*Holocarpha macradenia*	E
Tarplant, Santa Susana	*Hemizonia minthornii*	R
Thelypodium, slender-petaled	*Thelypodium stenopetalum*	E
Thistle, ashland	*Cirsium ciliolatum*	E
Thistle, fountain	*Cirsium fontinale* var. *fontinale*	E
Trefoil, San Clemente Island bird's foot	*Lotus argophyllus* ssp. *adsurgens*	E
Trefoil, Santa Cruz Island bird's foot	*Lotus argophyllus* ssp. *niveus*	E
Tuctoria, Crampton's	*Tuctoria mucronata*	E
Tuctoria, Greene's	*Tuctoria greenei*	R
Wallflower, Contra Costa	*Erysimum capitatum* var. *angustatum*	E
Wallflower, Menzies'	*Erysimum menziesii*	E

Table G-4. State-Designated Endangered and Threatened Species—California (continued)

Common name	Scientific name	Status
Plants (continued):		
Wallflower, Santa Cruz	*Erysimum teretifolium*	E
Woollystar, Santa Ana River	*Eriastrum densifolium* ssp. *sanctorum*	E

Note: Information as of April 1, 1988.

Table G-5. State-Designated Endangered and Threatened Species—Florida

Common name	Scientific name	Status
Mammals:		
Bat, gray	*Myotis grisescens*	E
Bat, Indiana	*Myotis sodalis*	E
Bear, Florida black	*Ursus americanus floridanus*	T[a]
Chipmunk, eastern	*Tamias striatus*	SSC
Deer, Key	*Odocoileus virginianus clavium*	E
Gopher, Goff's pocket	*Geomys pinetis goffi*	E
Manatee, West Indian	*Trichechus manatus latirostris*	E
Mink, Everglades	*Mustela vison evergladensis*	T
Mouse, Chadwick Beach cotton	*Peromyscus gossypinus restictus*	E
Mouse, Chotawatchee beach	*Peromyscus polionotus allophrys*	E
Mouse, Florida	*Peromyscus floridanus*	SSC
Mouse, Key Largo cotton	*Peromyscus gossypinus allapaticola*	E
Mouse, pallid beach	*Peromyscus polionotus decoloratus*	E
Mouse, Perdido Key beach	*Peromyscus polionotus trissyllepsis*	E
Panther, Florida	*Felis concolor coryi*	E
Rat, Sanibel Island rice	*Oryzomys palustris sanibeli*	SSC
Rat, silver rice	*Oryzomys argentatus*	E
Shrew, Homosassa	*Sorex longirostris eionis*	SSC
Shrew, Sherman's short-tailed	*Blarina carolinensis (=brevicauda) shermani*	SSC
Squirrel, big cypress fox	*Sciurus niger avicennia*	T
Squirrel, Sherman's	*Sciurus niger shermani*	SSC
Vole, Duke's saltmarsh	*Microtus pennsylvanicus dukecampbelli*	SSC
Whale, finback	*Balaenoptera physalus*	E
Whale, humpback	*Megaptera novaeangliae*	E
Whale, right	*Balaena glacialis*	E
Whale, Sei	*Balaenoptera borealis*	E
Whale, sperm	*Physter catodon*	E
Woodrat, Key Largo	*Neotoma floridana smalli*	E
Birds:		
Caracara, Audubon's crested	*Polyborus plancus audubonii*	T
Crane, Florida sandhill	*Grus canadensis pratensis*	T
Eagle, bald	*Haliaeetus leucocephalus*	T
Egret, reddish	*Egretta rufescens*	SSC
Egret, snowy	*Egretta thula*	SSC

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Birds (continued):		
Falcon, Arctic peregrine	*Falco peregrinus tundrius*	E
Heron, little blue	*Egretta caerulea*	SSC
Heron, Louisiana tricolored	*Egretta tricolor*	SSC
Jay, Florida scrub	*Aphelocoma coerulescens coerulescens*	T
Kestrel, southeastern American	*Falco sparverius paulus*	T
Kite, Everglade snail	*Rostrhamus sociabilis*	E
Limpkin	*Aramus guarauna*	SSC
Osprey	*Pandion haliaetus*	SSC[a]
Owl, burrowing	*Athene cunicularia*	SSC
Oystercatcher, American	*Haematopus palliatus*	SSC
Pelican, brown	*Pelecanus occidentalis*	SSC
Pigeon, white-crowned	*Columba leucocephala*	T
Plover, piping	*Charadrius melodus*	T
Plover, southeastern snowy	*Charadrius alexandrinus tenuirostris*	T
Sparrow, Cape Sable seaside	*Ammodramus maritimus mirabilis*	E
Sparrow, dusky seaside	*Ammodramus maritimus nigriscens*	E[b]
Sparrow, Florida grasshopper	*Ammodramus savannarum floridanus*	E
Sparrow, Scott's seaside	*Ammodramus maritimus peninsulae*	SSC
Sparrow, Wakulla seaside	*Ammodramus maritimus juncicolus*	SSC
Spoonbill, roseate	*Ajaia ajaja*	SSC
Stork, wood	*Mycteria americana*	E
Tern, least	*Sterna antillarum*	T
Tern, roseate	*Sterna dougallii*	T
Warbler, Bachman's	*Vermivora bachmanii*	E
Warbler, Kirtland's	*Dendroica kirtlandii*	E
Woodpecker, ivory-billed	*Campephilus principalis*	E
Woodpecker, red-cockaded	*Picoides (=Dendrocopus) borealis*	T
Wren, Marian's marsh	*Cistothorus palustris marianae*	SSC
Wren, Worthington's marsh	*Cistothorus palustris griseus*	SSC
Reptiles:		
Snakes—		
Snake, Atlantic salt marsh water	*Nerodia fasciata taeniata*	T
Snake, big pine key ringneck	*Diadophis punctatus acricus*	T
Snake, eastern indigo	*Drymarchon corais couperi*	T

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Reptiles (continued):		
Snake, Florida brown	*Storeria dekayi victa*	T[a]
Snake, Florida pine	*Pituophis melanoleucus mugitus*	SSC
Snake, Florida ribbon	*Thamnophis sauritus sackeni*	T[a]
Snake, Miami black-headed/ rimrock crowned	*Tantilla oolitica*	T
Snake, red rat	*Elaphe guttata guttata*	SSC[a]
Snake, short-tailed	*Stilosoma extenuatum*	T
Turtles—		
Cooter, Suwannee	*Chrysemys (=Pseudemys) concinna suwanniensis*	SSC
Tortoise, gopher	*Gopherus polyphemus*	SSC
Turtle, alligator snapping	*Macroclemys temmincki*	SSC
Turtle, Atlantic green	*Chelonia mydas mydas*	E
Turtle, Atlantic hawksbill	*Eretmochelys imbricata imbricata*	E
Turtle, Atlantic loggerhead	*Caretta caretta caretta*	T
Turtle, Atlantic ridley	*Lepidochelys kempi*	E
Turtle, Barbour's map	*Graptemys barbouri*	SSC
Turtle, leatherback sea	*Dermochelys coriacea*	E
Turtle, striped mud	*Kinosternon bauri*	E[a]
Lizards—		
Alligator, American	*Alligator mississippiensis*	SSC
Crocodile, American	*Crocodylus acutus*	E
Skink, Florida Keys mole	*Eumeces egregius egregius*	SSC
Skink, blue-tailed mole	*Eumeces egregius lividus*	T
Skink, sand	*Neoseps reynoldsi*	T
Amphibians:		
Salamanders—		
Salamander, Georgia blind	*Haideotriton wallacei*	SSC
Frogs and toads—		
Frog, bog	*Rana okaloosae*	SSC

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Amphibians (continued):		
Frog, gopher	*Rana areolata*	SSC
Treefrog, pine barrens	*Hyla andersonii*	SSC
Fish:		
Bass, shoal	*Micropterus* sp. (undescribed)	SSC
Bass, Suwannee	*Micropterus notius*	SSC
Blenny, key	*Starksia starcki*	SSC
Darter, crystal	*Ammocrypta asprella*	T
Darter, harlequin	*Etheostoma histrio*	SSC
Darter, Okaloosa	*Etheostoma okaloosae*	E
Darter, southern tessellated	*Etheostoma olmstedi maculaticeps*	SSC
Pupfish, Lake Eustis	*Cyprinodon variegatus hubbsi*	SSC
Rivulus	*Rivulus marmoratus*	SSC
Shiner, blackmouth	*Notropis* sp. (undescribed)	E
Shiner, bluestrip	*Notropis callitaenia*	SSC
Silverside, key	*Menidia conchorum*	T
Snook, common	*Centropomus undecimalis*	SSC
Sturgeon, Atlantic	*Acipenser oxrhynchus*	SSC
Sturgeon, shortnose	*Acipenser brevirostrum*	E
Topminnow, saltmarsh	*Fundulus jenkinsi*	SSC
Invertebrates:		
Butterfly, Schaus swallowtail	*Heraclides (=Papilio) aristodemus ponceanus*	E
Coral, pillar	*Dendrogyra cylindrus*	E
Mollusks:		
Snail, Florida tree	*Liguus fasciatus*	SSC
Snail, Stock Island	*Orthalicus reses*	E
Plants:		
Anemone, rue	*Anemonella thalictroides*	T
Anise, Florida	*Illicium floridanum*	T
Anise, yellow	*Illicium parviflorum*	T
Apple, balsam	*Clusia rosea*	E

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Apple, West Coast prickly	*Cereus gracilis*	E
Arbutus, trailing	*Epigaea repens*	E
Aster, Cruise's golden	*Chrysopsis cruiseana*	E
Aster, Florida golden	*Chrysopsis floridana*	E
Aster, panhandle golden	*Pityopsis flexuosa*	E
Aster, pinewoods	*Aster spinulosus*	
Autumngrass, riparium	*Schizachyrium niveum*	E
Azalea, Alabama	*Rhododendron alabamense*	E
Azalea, orange/Florida	*Rhododendron austrinum*	E
Balm, long-spurred/robin's mint	*Dicerandra cornutissima*	E
Balm, scrub/Lloyd's mint	*Dicerandra frutescens*	E
Balm, spotless-petaled Lakela's mint	*Dicerandra immaculata*	E
Baneberry	*Actaea pachypoda*	T
Bear-grass, Florida	*Nolina atopocarpa*	E
Beauty, Harper	*Harperocallis flava*	E
Bellflower, Robins'/ Chinsegut	*Campanula robinsiae*	E
Birds-in-a-nest, white	*Macbridea alba*	E
Bladder-nut	*Staphylea trifolia*	T
Bluestem, pinewoods	*Andropogon arctatus*	T
Bonamia, Florida/ large-flowered	*Bonamia grandiflora*	E
Brickell-bush, Flyr's	*Brickellia cordifolia*	T
Bromeliad, Fuch's	*Guzmania monostachia*	E
Buckthorn	*Bumelia lycioides*	T
Buckwheat, scrub	*Eriogonum floridanum*	T
Burmannia, Fakahatchee	*Burmannia flava*	E
Butterfly-pea, pigeon-wing	*Clitoria fragrans*	E
Buttons, Barbara's	*Marshallia abovata*	T
Cactus, dildoe	*Cereus pentagonus*	T
Cactus, mistletoe	*Rhipsalis baccifera*	E
Cactus, semaphore	*Opuntia stricta*	T
Cactus, Key tree-	*Cereus robinii*	E
Camellia, silky	*Stewartia malacodendron*	E

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Caps, broad-leaved nodding/broad-leaved pogonia	*Triphora latifolia*	T
Caps, nodding	*Triphora cubensis*	T
Caps, nodding	*Triphora gentianoides*	T
Caps, nodding	*Triphora rickettii*	T
Catopsis, nodding	*Catopsis nutans*	E
Catopsis, powdery	*Catopsis berteroniana*	E
Cedar, bay	*Suriana maritima*	E
Cereus, fragrant wool-bearing/fragrant prickly	*Cereus eriophorus* var. *fragrans*	E
Cereus, night-blooming/queen of the night	*Cereus undatus*	T
Clustervine, beach/reclined	*Jacquemontia reclinata*	E
Clustervine, pineland/Curtiss	*Jacquemontia curtissii*	E
Coco, false	*Eulophia ecristata*	T
Coco, wild/ground	*Eulophia alta*	T
Coco, wild	*Pteroglossaspis ecristata*	T
Coral-root, autumn	*Corallorhiza odontorhiza*	T
Coral-root, crested	*Hexalectris spicata*	T
Coral-root, spring/Wister's	*Corallorhiza wisteriana*	T
Corkwood, Florida	*Leitneria floridana*	T
Cotton, wild	*Gossypium hirsutum*	E
Crab-apple	*Malus angustifolia*	
Creeper, beach	*Ernodia littoralis*	T
Croomia, few-flowered	*Croomia pauciflora*	E
Crownbeard, Chapman's	*Verbesina chapmanii*	T
Cumber-root, Indian	*Medeola viginiana*	T
Cupania	*Cupania glabra*	E
Dainties, pinewood/Florida flower leaf	*Phyllanthus liebmannianus*	T
Day-flower, climbing	*Commelina gigas*	T
Dogwood, pagoda	*Cornus alternifolia*	T
Dropwort, giant water/giant cowbane water	*Oxpolis greenmanii*	
Epidendrum, Acuna's	*Epidendrum acunae*	E

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Epidendrum, dingy-flowered	*Epidendrum anceps*	T
Epidendrum, dwarf	*Encyclia pygmaea*	E
Epidendrum, night-smelling/ night-scent orchid	*Epidendrum nocturnum*	T
Epidendrum, rigid	*Epidendrum rigidum (=strobiliferum)*	T
Epidendrum, unbelled	*Epidendrum difforme*	T
Erythrodes, low	*Erythrodes querceticola*	T
Fern, adder's tongue	*Ophioglossum nudicaule*	T
Fern, adder's tongue	*Ophioglossum petiolatum*	T
Fern, adder's tongue	*Ophioglossum vulagatum*	T
Fern, Ames' halberd	*Tectaria amesiana*	T
Fern, aspidium	*Thelypteris augescens*	T
Fern, aspidium	*Thelypteris hispidula*	T
Fern, aspidium	*Thelypteris interrupta*	T
Fern, aspidium	*Thelypteris kunthiii*	T
Fern, aspidium	*Thelypteris ovata*	T
Fern, aspidium	*Thelypteris quadrangularis*	T
Fern, aspidium	*Thelypteris resinifera*	T
Fern, aspidium	*Thelypteris reticulata*	T
Fern, aspidium	*Thelypteris sclerophylla*	T
Fern, aspidium	*Thelypteris serrata*	T
Fern, aspidium	*Thelypteris tetragona*	T
Fern, Boston	*Nephrolepis biserrata*	T
Fern, brake	*Pteris vittata*	T
Fern, bracken	*Trismeria trifoliata*	T
Fern, Christmas	*Polystichum acrostichoides*	T
Fern, cliff brake	*Pellaea atropurpurea*	T
Fern, climbing	*Lygopodium palmatum*	T
Fern, comb (unnamed)	*Ctenitis sloanei*	T
Fern, comb (unnamed)	*Ctenitis submarginalis*	T
Fern, creeping	*Thelypteris reptans*	T
Fern, cretan brake	*Pteris cretica*	T
Fern, cuplet/hay-scented	*Dennstaedtia bipinnata*	E
Fern, downy shield	*Thelypteris dentata*	T
Fern, filmy	*Trichomanes holopterum*	T

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Fern, filmy	*Trichomanes krausii*	T
Fern, filmy	*Trichomanes lineolatum*	T
Fern, filmy	*Trichomanes petersii*	T
Fern, filmy	*Trichomanes punctatum*	T
Fern, flakelet	*Hypolepis repens*	T
Fern, fragrant maidenhair	*Adiantum melanoleucum*	E
Fern, giant brake	*Pteris tripartita*	T
Fern, giant leather	*Acrostichum danaeifolium*	T
Fern, golden leather	*Acrostichum aureum*	E
Fern, grape	*Botrychium dissectum*	T
Fern, halberd	*Tectaria heracleifolia*	T
Fern, halberd	*Tectaria incisa*	T
Fern, halberd	*Tectaria lobata*	T
Fern, hand adder's tongue	*Ophioglossum palmatum*	E
Fern, Hattie Bauer halberd/ hairy halberd	*Tectaria coriandrifolia*	E
Fern, holly	*Lomariopsis kunzeana*	T
Fern, ladder brake	*Pteris longifolia*	T
Fern, limestone adder's tongue	*Ophioglossum engalmannii*	T
Fern, maidenhair	*Adiantum tenerum*	T
Fern, marsh	*Thelypteris palustris*	T
Fern, mosquito	*Azolla caroliniana*	T
Fern, narrow strap	*Campyloneurum angustifolium*	E
Fern, net	*Dicranopteris flexuosa*	T
Fern, netted chain	*Woodwardia areolata*	T
Fern, parsley	*Sphenomeris clavata*	T
Fern, pine	*Anemia adiantifolia*	T
Fern, polypody	*Microgrammna heterophylla*	T
Fern, polypody	*Goniophlebium triseriale*	T
Fern, polypody	*Polypodium dispersum*	T
Fern, polypody	*Polypodium plumula*	T
Fern, polypody	*Polypodium ptilodon*	T
Fern, rattlesnake	*Botrychium virginianum*	T
Fern, ribbon	*Paltonium lanceolatum*	T
Fern, sensitive/bead	*Onoclea sensibilis*	T

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Fern, shoestring	*Vittaria lineata*	T
Fern, sinkhole	*Blechnum occidentale*	E
Fern, southern beech	*Thelypteris hexagonoptera*	T
Fern, southern lady	*Athyrium asplenioides*	T
Fern, southern grape	*Botrychium biternatum*	T
Fern, southern lip	*Cheilanthes microphylla*	T
Fern, star-scale	*Pleopeltis revoluta*	T
Fern, strap	*Campyloneurum latum*	T
Fern, strap	*Campyloneurum costatum*	T
Fern, strap	*Campyloneurum phyllitidus*	T
Fern, tropical curly-grass/ray	*Schizaea germanii*	E
Fern, Venus-hair	*Adiantum capillus-veneris*	E
Fern, water-horn	*Ceratopteris pterioides*	T
Fern, water-horn	*Ceratopteris thalictroides*	T
Fern, whisk/fork	*Psilotum nudum*	T
Fern, winter grape	*Botrychium lunarioides*	T
Fevertree, hairy	*Pinckneya pubens (=bracteata)*	T
Flax, sand	*Linum arenicola*	E
Flax, West's	*Linum westii*	T
Florida variegated oncidium	*Oncidium variegatum*	E
Flower, cardinal	*Lobelia cardinalis*	T
Four-o'clock, burrowing	*Okenia hypogaea*	E
Fringe-tree, pigmy	*Chionanthus pygmaeus*	E
Garberia	*Garberia heterophylla*	T
Gayfeather, Florida/scrub blazing star	*Liatris ohlingerae*	E
Gentian, wiregrass	*Gentiana pennelliana*	E
Gooseberry, Miccosukee	*Ribes echinellum*	E
Gourd, Okeechobee	*Cucurbita okeechobeensis*	E
Grass, Florida/Key West three-awn	*Aristida floridana*	E
Grass, Harper's/harsh-leaf yellow-eyed	*Xyris scabrifolia*	T
Grass, Karst Pond/Kral's yellow-eyed	*Xyris longisepala*	E

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Hackberry, iguana	*Celtis iguanaea*	E
Hackberry, spiny	*Celtis pallida*	E
Hartwrightia, Florida	*Hartwrightia floridana*	T
Heartleaf	*Hexastylis arifolia*	T
Hellebore, Woods' false	*Veratrum woodii*	E
Hibiscus, yellow	*Cienfuegosia heterophylla*	T
Holly, Carolina/sandy	*Ilex ambigua*	T
Holly, Krug's	*Ilex krugiana*	T
Honewort	*Cryptotaenia canadensis*	T
Honeysuckle, swamp	*Rhododendron viscosum*	T
Hydrangea, wild	*Hydrangea arborescens*	T
Indigo, Apalachicola wild	*Baptisia megacarpa*	T
Indigo, coastal plain wild/scareweed	*Baptisia simplicifolia*	T
Indigo, hairy wild	*Baptisia hirsuta*	T
Inkberry	*Scaevola plumieri*	T
Inkwood	*Hypelate trifoliata*	T
Ionopsis, delicate/violet orchid	*Ionopsis utricularioides*	E
Ironwood, redberry	*Eugenia confusa*	T
Ixia, Bartram's	*Sphenostigma coelestinum*	T
Joewood	*Jacquinia keyensis*	T
Jointweed, hairy/wireweed	*Polygonella basiramia*	
Jointweed, large-leaved	*Polygonella macrophylla*	T
Ladies'-tresses, Florida	*Spiranthes brevilabris* var. *floridana*	T
Ladies'-tresses, Florida Keys/ green ladies'	*Spiranthes polyantha*	E
Ladies'-tresses, fragrant	*Spiranthes cernua* var. *odorata*	T
Ladies'-tresses, giant/ grass-leaved	*Spiranthes pracox*	T
Ladies'-tresses, lace-lip/lace-lip spiral orchid	*Spiranthes laciniata*	T
Ladies'-tresses, little/ little pearl twist	*Spiranthes tuberosa*	T
Ladies'-tresses, long-lip	*Spiranthes longilabris*	T
Ladies'-tresses, oval	*Spiranthes ovalis*	T

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Ladies'-tresses, red-flowered/ lace-lip	*Spiranthes lanceolata* var. *paludicola*	T
Ladies'-tresses, scarlet	*Spiranthes orchioides*	T
Ladies'-tresses, slender	*Spiranthes gracilis*	T
Ladies'-tresses, southern	*Spiranthes tortilis*	T
Ladies'-tresses	*Spiranthes costaricensis*	T
Ladies'-tresses	*Spiranthes cranichoides*	T
Ladies'-tresses	*Spiranthes lanceolata* var. *luteoalba*	T
Ladies'-tresses, spring	*Spiranthes vernalis*	T
Ladies'-tresses, Texas	*Spiranthes brevilabris* var. *brevilabris*	T
Lady, Coot Bay dancing/spread-eagle oncidium	*Oncidium carthagenense*	
Laurel, mountain-	*Kalmia latifolia*	T
Lavender, sea	*Mallotonia gnaphalodes*	E
Licaria	*Licaria triandra*	E
Lilies, rain	*Zephyranthes* (all white species)	E
Lily, Catesby	*Lilium catesbaei*	T
Lily, dogtooth/dimpled dogtooth violet	*Erythronium umbilicatum*	T
Lily, panhandle	*Lilium iridollae*	E
Lily, Simpson zephyr	*Zephyranthes simpsonii*	E
Lily-thorn, small-flowered/ dune	*Catesbaea parviflora*	E
Liverleaf	*Hepatica americana*	E
Lovegrass, Sanibel Island	*Eragrostis tracyi*	T
Lupine, Gulfcoast/panhandle	*Lupinus westianus*	T
Lupine, McFarlin's/scrub	*Lupinus aridorum*	E
Macradenia, Trinidad	*Macradenia lutescens*	T
Magnolia, Ashe's	*Magnolia ashei*	E
Magnolia, pyramidal	*Magnolia pyramidata*	E
Mahogany, West Indian	*Swietenia mahognia*	T
Malaxis, Florida/Florida adder's mouth	*Malaxis spicata*	T
Mallow, poppy-	*Callirhoe papaver*	T
Manchineel	*Hippomane mancinella*	T

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Meadow-beauty, small-flowered/ Apalachicola	*Rhexia parviflora*	
Meadow-beauty, yellow	*Rhexia lutea*	T
Milkpea, Small's	*Galactia smallii*	
Milkweed, Alabama/Alabama anglepod	*Matela alabamensis*	E
Milkweed, Curtiss	*Asclepias curtissii*	T
Milkweed, southern/green	*Asclepias virdula*	T
Milkwort, big yellow	*Polygala rugelii*	T
Milkwort, scrub	*Polygala lewtonii*	E
Milkwort, tiny/Small's	*Polygala smallii*	E
Mistletoe, mahogany	*Phoradendron rubrum*	E
Moss, foxtail club	*Lycopodium alopecuroides*	T
Moss, hanging club/coneless club	*Lycopodium dichotomum*	E
Moss, nodding club	*Lycopodium cernuum*	T
Moss, prostrate club/harper's club	*Lycopodium prostratum*	T
Moss, slender club	*Lycopodium carrolinianum*	T
Moss, southern club	*Lycopodium appressum*	T
Mouth, green adder's	*Malaxis unifolia*	T
Mustard, Carter's	*Warea carteri*	E
Nailwort, paper-like/papery whitlow-wort	*Paronychia chartacea*	
Neottia, spurred	*Centrogenium cetaceum*	E
Neottia, tall	*Spiranthes elata*	T
Nodding-caps, Craighead's/pogonia	*Triphora craigheadii*	T
Oncidium, Florida	*Oncidium floridanum*	T
Orchid (unnamed)	*Cranichis muscosa*	T
Orchid (unnamed)	*Cyrtopodium andersonii*	T
Orchid, butterfly	*Encyclia tampensis*	T
Orchid, cowhorn/cigar	*Cyrtopodium punctatum*	E
Orchid, crane-fly	*Tipularia discolor*	E
Orchid, dancing lady/Florida variegated oncidium	*Oncidium variegatum*	E
Orchid, dollar/clamshell	*Encyclia cochleata*	T
Orchid, dollar/dogtooth	*Encyclia boothiana*	E
Orchid, ghost/palm polly	*Polyrrhiza lindenii*	E

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Orchid, golden fringed/ crested fringed	*Platanthera cristata*	T
Orchid, greenfly	*Epidendrum canopseum*	T
Orchid, Harris' tiny	*Lepanthopsis melanantha*	E
Orchid, hidden	*Maxillaria crassifolia*	E
Orchid, large white fringed	*Platanthera blephariglottis*	T
Orchid, leafless	*Campylocentrum pachyrrhizum*	E
Orchid, leafless beaked	*Spiranthes lanceolata* var. *lanceolata*	T
Orchid, little club-spur/small green wood	*Platanthera clavellata*	T
Orchid, long-tailed spider	*Brassia caudata*	T
Orchid, Michaux's/long-horned	*Habenaria quinquesta*	T
Orchid, mule-ear/dingy-flowered	*Oncidium luridum*	T
Orchid, rattail	*Bulbophyllum pachyrrhachis*	E
Orchid, rein	*Habenaria distans*	T
Orchid, rein	*Habenaria odontopetala*	T
Orchid, rosebud/spreading pogonia	*Cleistes divaricata*	T
Orchid, snake	*Restrepiella ophiocephala*	E
Orchid, snowy/bog torch	*Platanthera nivea*	T
Orchid, southern tubercled/ gypsy-spikes	*Platanthera flava*	T
Orchid, southern yellow fringeless	*Platanthera integra*	T
Orchid	*Basiphyllaea corallicola*	T
Orchid	*Bletia patula*	T
Orchid	*Galeandra beyrichii*	T
Orchid	*Govenia utriculata*	T
Orchid	*Harrisella filiformis*	T
Orchid	*Harrisella porrecta*	T
Orchid	*Leochilus labiatus*	T
Orchid	*Pleurothallis gelida*	T
Orchid	*Potamogeton floridanus*	T
Orchid	*Tetramicra canaliculata bicolor*	T
Orchid, tall liparis	*Liparis elata*	T
Orchid, water spider/creeping	*Habenaria repens*	T
Orchid, worm-vine/link vine	*Vanilla barbellata*	E

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Orchid, yellow fringed	*Platanthera ciliaris*	T
Orchid, young-palm	*Tropidia polystachya*	E
Palm, buccaneer/Sargent's cherry	*Pseudophoenix sargentii*	E
Palm, coconut	*Cocos nucifera*	T
Palm, Florida royal	*Roystonea elata*	E
Palm, paurotis/Everglades	*Acoelorrhaphe wrightii*	T
Palmetto, dwarf/bluestem	*Sabal minor*	T
Palmetto, scrub	*Sabal etonia*	T
Parnassus, Grass-of-	*Parnassia grandifolia*	E
Pawpaw, four-petal/opossum	*Asimina tetramera*	E
Pawpaw, Rugel's/yellow squirrel-banana	*Deeringothamnus rugelii*	E
Pawpaw, slim-petal/beautiful/ white squirrel-banana	*Deeringothamnus pulchellus*	E
Pea, big pine partridge/ Florida Keys senna	*Cassia keyensis*	E
Pear, prickly	*Opuntia cubensis*	T
Pear, twistpine prickly	*Opuntia compressa*	T
Pennyroyal, mock	*Hedeoma graveolens*	E
Peperomia, cypress	*Peperomia glabella*	E
Peperomia, Everglades	*Peperomia floridana*	E
Peperomia, Florida	*Peperomia obtusifolia*	E
Peperomia, spatulate	*Peperomia spathulifolia*	E
Pepper	*Peperomia humilis*	E
Pepperwort, hairy/hairy waterclover	*Marsilea mucronata*	T
Pine, pride-of-big	*Strumpfia maritima*	E
Pine, wild/air plant	*Tillandsia circinata*	T
Pine, wild/air plant	*Tillandsia polystachia*	T
Pine, wild/air plant	*Tillandsia setacea*	T
Pine, wild/air plant	*Tillandsia paucifolia*	T
Pine, wild/air plant	*Tillandsia simulata*	T
Pine, wild/air plant	*Tillandsia balbisiana*	T
Pinesap	*Monotropa hypopithys*	E
Pink, bearded grass	*Calopogon barbatus*	T
Pink, grass	*Calopogon pulchellus*	T
Pink, grass	*Calopogon tuberosus*	T

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Pink, many-flowered grass	*Calopogon multiflorus*	T
Pink, pale grass	*Calopogon pallidus*	T
Pink, pine	*Bletia purpurea*	T
Pinkroot, Florida/levy	*Spigelia loganioides*	E
Pinkroot, gentian/panhandle	*Spigelia gentianoides*	E
Pipe, Dutchman's	*Aristolochia tomentosa*	T
Pipes, pigmy/pinesap, sweet	*Monotropsis reynoldsiae*	E
Pitcher-plant, hooded	*Sarracenia minor*	T
Pitcher-plant, red-flowered/ pitcher-plant, sweet	*Sarracenia rubra*	E
Pitcher-plant, white-top	*Sarrracenia leucophylla*	E
Plant, air	*Catopsis floribunda*	E
Plant, crenulate/Miami lead	*Amorpha crenulata*	E
Plant, fuzzy-wuzzy air	*Tillandsia pruinosa*	E
Plant, twisted air	*Tillandsia flexuosa*	T
Plantain, variable-leaved Indiana	*Cacalia diversifolia*	T
Pleat-leaf, fall-flowering/celestial lily	*Nemastylis floridana*	E
Plum, scrub	*Prunus geniculata*	T
Pogonia, nodding/three-birds orchid	*Triphora trianthophora*	T
Pogonia, rose	*Pogonia ophioglossoides*	T
Pogonia, whorled	*Isotria verticillata*	T
Polypody, golden	*Phlebodium aureum*	T
Polystachya, pale-flowered	*Polystachya flavescens*	T
Possumshaw	*Ilex decidua*	T
Quillwort, Chapman's	*Isoetes chapmanii*	T
Quillwort, Engelmann's	*Isoetes engelmannii*	T
Quillwort, Florida	*Isoetes flaccida*	T
Rhododendron, Chapman's	*Rhododendron chapmanii*	E
Rosemary, Apalachicola/panhandle	*Conradina glabra*	T
Ruellia, night-flowering	*Ruellia noctiflora*	T
Rush, scouring	*Equisetum hymale*	T
Sachsia, Bahama	*Sachsia bahamensis*	E
Satinleaf	*Chrysophyllum olivaeforme*	E
Savory, Ashe's/basil lavender	*Calamintha ashei*	T

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Schisandra	*Schisandra glabra*	T
Snakeroot, wedge-leaved button	*Eryngium ameifolium*	
Spice, pond/pond bush	*Litsea aestivalis*	T
Spicebush, swamp/Jove's fruit/pondberry	*Lindera melissifolia*	
Spikemoss, armored	*Selaginella armata*	T
Spikemoss, meadow	*Selaginella apoda*	T
Spikemoss, sand	*Selaginella arenicola*	T
Spikemoss, sp.	*Selaginella uncinata*	T
Spikemoss, sp.	*Selaginella ludoviciana*	T
Spikemoss, sp.	*Selaginella plana*	T
Spleenwort (unnamed)	*Asplenium subtile*	T
Spleenwort (unnamed)	*Asplenium trichomanes-dentatum*	T
Spleenwort (unnamed)	*Asplenium verecundum*	T
Spleenwort, auricled	*Asplenium auritum*	E
Spleenwort, bird's nest; fern, wild birdnest,	*Asplenium serratum*	E
Spleenwort, double	*Asplenium plenum*	T
Spleenwort, dwarf/ chervil	*Asplenium pumilum*	E
Spleenwort, ebony	*Asplenium platyneuron*	T
Spleenwort, little ebony	*Asplenium resiliens*	T
Spleenwort, single sorus/ San Felasco	*Asplenium monanthes*	E
Spleenwort, slender	*Asplenium dentatum*	T
Spleenwort	*Asplenium cristatum*	
Spleenwort	*Asplenium abscissum*	T
Spleenwort	*Asplenium heterochorum*	T
Spleenwort, Wagner's/ mixed	*Asplenium heteroresiliens*	T
Spurge, Allegheny	*Pachysandra procumbens*	E
Spurge, Garber's	*Euphorbia garberi*	E
Spurge, wedge/deltoid	*Euphorbia deltoidea deltoidea*	
St. John's-Susan	*Rudbeckia nitida*	E
St. John's-wort, Edison/Edison's Ascyrum	*Hypericum edsonianum*	T

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
St. John's-wort, highlands scrub	*Hypericum cumulicola*	E
St. John-wort, smooth-barked	*Hypericum lissophloeus*	E
Star, beach	*Remirea maritima*	E
Star, Godfrey's blazing/Godfrey's gayfeather	*Liatris provincialis*	E
Stopper, red	*Eugenia rhombea*	E
Sundew, water	*Drosera intermedia*	T
Sweetshrub	*Calycanthus floridus*	T
Tamarindillo	*Acacia choriophylla*	E
Tear-thumb, Mexican	*Polygonum meisnerianum*	T
Tetrazysgia	*Tetrazygia bicolor*	T
Torch, bog	*Habenaria nivea*	T
Torreya, Florida	*Torreya taxifolia*	T
Tree, cucumber	*Magnolia acuminata*	T
Tree, geiger	*Cordia sebestena*	E
Tree, lignum-vitae	*Guaiacum sanctum*	E
Twayblade, southern	*Listera aestivalis*	T
Vanilla, commercial	*Vanilla planifolia*	T
Vanilla, leafless	*Vanilla dilloniana*	T
Vanilla, leafy/oblong-leaved	*Vanilla phaeantha*	T
Vanilla, scentless	*Vanilla inodora*	T
Vanilla sp.	*Vanilla mexicana*	T
Vetch, Ocala	*Vicia ocalensis*	E
Vine, lemon/blade apple cactus	*Pereskia aculeata*	T
Violet, halberd-leaved yellow	*Viola hastata*	E
Wake-robin, lance-leaved	*Trillium lancifolium*	E
Warea, clasping/wide-leaf	*Warea amplexifolia*	E
Water-willow, Cooley's	*Justicia cooleyi*	E
Willow, Florida	*Salix floridana*	T
Winterberry, common	*Ilex verticillata*	T
Winterberry, mountain	*Ilex montana*	T
Witch, shadow	*Ponthieva racemosa*	T
Woodsia, blunt-lobed	*Woodsia obtusa*	T

Table G-5. State-Designated Endangered and Threatened Species—Florida (continued)

Common name	Scientific name	Status
Plants (continued):		
Yellowheart	*Zanthoxylum flavum*	E
Yew, Florida	*Taxus floridana*	E

[a] Indicates not applicable in Baker and Columbia counties and Apalachicola National Forest. SSC indicates species of special concern.
[b] May be extinct.

Table G-6. State-Designated Endangered and Threatened Species—Georgia

Common name	Scientific name	Status
Mammals:		
Bat, gray	*Myotis grisescens*	E
Bat, Indiana	*Myotis sodalis*	E
Cougar, eastern	*Felis concolor cougar*	E
Gopher, Sherman's pocket	*Geomys fontanelus*	E
Manatee, West Indian	*Trichechus manatus*	E
Whale, humpback	*Megaptera novaeangliae*	E
Whale, right	*Balaena glacialis*	E
Birds:		
Eagle, southern bald	*Haliaeetus leucocephalus*	E
Falcon, American peregrine	*Falco peregrinus anatum*	E
Warbler, Bachman's	*Vermivora bachmanii*	E
Warbler, Kirtland's	*Dendroica kirtlandii*	E
Woodpecker, ivory-billed	*Campephilus principalis*	E
Woodpecker, red-cockaded	*Picoides(=Dendrocopus) borealis*	E
Reptiles:		
Snakes—		
Snake, eastern indigo	*Drymarchon corais couperi*	T
Turtles—		
Turtle, Atlantic ridley sea	*Lepidochelys kempii*	E
Turtle, hawksbill sea	*Eretmochelys imbricata*	E
Turtle, leatherback sea	*Dermochelys coriacea*	E
Amphibians:		
Salamanders—		
Salamander, Georgia blind	*Haideotriton wallacei*	U
Fish:		
Cavefish, southern	*Typhlichthys subterraneous*	E
Sturgeon, shortnose	*Acipenser brevirostrum*	E

Table G-6. State-Designated Endangered and Threatened Species—Georgia (continued)

Common name	Scientific name	Status
Plants:		
Arrow-wood	*Viburnum bracteatum*	E
Azalea, plumleaf	*Rhododendron prunifolium*	T
Bells, Oconee	*Shortia galacifolia*	T
Bluestem	*Schizachyrium niveum*	T
Buckthorn	*Bumelia thornei*	E
Cinquefoil, three-tooth	*Pontentilla tridentata*	E
Coneflower, smooth	*Echinacea laevigata*	T
Croomia	*Croomia pauciflora*	T
Dodder, Harper	*Cuscuta harperi*	T
Dragon-head, false	*Physostegia veroniciformis*	T
Dropwort, Canby	*Oxypolis canbyi*	T
Fimbristylis, Harper	*Fimbristylis perpusilla*	E
Flytrap, yellow	*Sarracenia flava*	T
Glade-cress	*Leavenworthia exigua*	T
Goldenseal	*Hydrastis canadensis*	E
Granite rock, stonecrop	*Sedum pusillum*	T
Hartwrightia	*Hartwrightia floridana*	T
Hellebore, wood false	*Veratrum woodii*	E
Lady-slipper, pink	*Cypripedium acaule*	U
Lady-slipper, yellow	*Cypripedium calceolus*	U
Loosestrife, Curtiss	*Lythrum curtissii*	E
Meadowrue, southern	*Thalictrum debile*	T
Oak, Oglethorpe	*Quercus oglethorpensis*	T
Olive, Indian	*Nestronia umbellula*	T
Panicgrass, Hirst	*Panicum hirstii*	E
Pimpernel, false	*Lindernia saxicola*	E
Pitcher-plant, green	*Sarracenia oreophila*	E
Pitcher-plant, hooded	*Sarracenia minor*	T
Pitcher-plant, northern	*Sarracenia purpurea*	E
Pitcher-plant, parrot	*Sarracenia psittacina*	T
Pitcher-plant, sweet	*Sarracenia rubra*	E
Pitcher-plant, whitetop	*Sarracenia leucophylla*	T
Plantain, Indian variable-leaf	*Cacalia diversifolia*	T
Plume, Georgia	*Elliottia racemosa*	E

Table G-6. State-Designated Endangered and Threatened Species—Georgia (continued)

Common name	Scientific name	Status
Plants (continued):		
Pogonia, small whorled	*Isotria medeoloides*	E
Pondberry	*Lindera melissifolia*	E
Pondspice	*Litsea aestivalis*	T
Quillwort, black-spored	*Isoetes melanospora*	T
Quillwort, mat-forming	*Isoetes tegetiformans*	E
Ragwort, Piedmont	*Senecio millefolium*	T
Rattleweed, hairy	*Baptisia arachnifera*	E
Rockcress, Georgia	*Arabis georgiana*	T
Savory, Ashe	*Calamintha ashei*	T
Sedge	*Carex amplisquama*	T
Sedge	*Carex misera*	T
Sedge, purple	*Carex purpurifera*	T
Sedge, Biltmore	*Carex biltmoreana*	T
Skullcap, large flower	*Scutellaria montana*	T
Spider lily, shoals	*Hymenocallis coronaria*	E
Spleenwort, Wagner	*Asplenium heteroresiliens*	T
Sprite, pool	*Amphianthus pusillus*	E
Star-flower	*Trientalis borealis*	E
Starvine, bay	*Schisandra glabra*	T
Strawberry, Piedmont barren	*Waldsteinia lobata*	T
Torreya, Florida	*Torreya taxifolia*	E
Trillium, persistent	*Trillium persistens*	E
Twinleaf	*Jeffersonia diphylla*	E
Water-milfoil, Piedmont	*Myriophyllum laxum*	T
Whitlow-grass, open-ground	*Draba aprica*	E
Willow, Florida	*Salix floridana*	E
Witch-alder, dwarf	*Fothergilla gardenii*	T

Note: Status as of April 5, 1988.

Table G-7. State-Designated Endangered and Threatened Species—Kansas

Common name	Scientific name	Status
Mammals:		
Bat, gray	*Myotis grisescens*	E
Ferret, black-footed	*Mustela nigripes*	E
Skunk, eastern spotted	*Spilogale putoris interrupta*	T
Birds:		
Crane, whooping	*Grus americana*	E
Curlew, Eskimo	*Numenius borealis*	E
Eagle, bald	*Haliaeetus leucocephalus*	E
Falcon, American peregrine	*Falco peregrinus anatum*	E
Ibis, white-faced	*Plegadis chihi*	T
Plover, piping	*Charadrius melodus*	T
Plover, snowy	*Charadrius alexandrinus*	T
Tern, least	*Sterna antillarum*	E
Reptiles:		
Snakes—		
Snake, checkered garter	*Thamophis marcianus marcianus*	T
Snake, eastern hognose	*Heterodon platyrhinos*	T
Snake, Kansas glossy	*Arizona elegans elegans*	T
Snake, New Mexico blind	*Leptotyphlops dulcis dissectus*	T
Snake, northern redbelly	*Storeria occipitomaculata occipitomaculata*	T
Snake, Texas longnose	*Rhinocheilus lecontei tessellatus*	T
Snake, Texas night	*Hypsiglena torquata jani*	T
Snake; western earth	*Virginia valeriae elegans*	T
Lizards—		
Skink, broadhead	*Eumeces laticepe*	T
Amphibians:		
Salamanders—		
Newt, central	*Notophthalmus viridescens louisianensis*	T
Salamander, cave	*Eurycea lucifuga*	E
Salamander, dark-sided	*Eurycea longicauda melanopleura*	T
Salamander, graybelly	*Eurycea multiplicata griseogaster*	E
Salamander, grotto	*Typhlotriton spelaeus*	E

Table G-7. State-Designated Endangered and Threatened Species—Kansas (continued)

Common name	Scientific name	Status
Amphibians (continued):		
Frogs and toads—		
Frog, green	*Rana clamitans melanota*	T
Frog, northern crawfish	*Rana areolata circulosa*	T
Frog, Strecker's chorus	*Pseudacris streckeri streckeri*	T
Peeper, northern spring	*Hyla crucifer crucifer*	T
Toad, eastern narrowmouth	*Gastrophryne carolinensis*	T
Toad, western green	*Bufo debilis insidior*	T
Fish:		
Chub, flathead	*Hybopsis gracilis*	T
Chub, hornyhead	*Nocomis biguttatus*	T
Chub, redspot	*Nocomis asper*	T
Chub, sicklefin	*Hybopsis meeki*	E
Chub, speckled	*Hybopsis aestivalis tetranemus*	E
Darter, Arkansas	*Etheostoma cragini*	T
Lamprey, chestnut	*Ichthyomyzon castaneus*	T
Madtom, Neosho	*Noturus placidus*	T
Shiner, Arkansas River	*Notropis girardi*	E
Shiner, silverband	*Notropis shumardi*	T
Sturgeon, pallid	*Scaphirhynchus albus*	E
Mollusks:		
Mussel, heel-splitter	*Anodonta suborbiculata*	E
Snail, amphibious	*Pomatiopsis lapidaria*	E
Arthropods:		
Beetle, Scott riffle	*Optioservus phaeus*	T

Table G-8. State-Designated Endangered and Threatened Species—Louisiana

Common name	Scientific name	Status
Mammals:		
Panther, Florida	*Felis concolor coryi*	E
Seal, Caribbean monk	*Monachus tropicalis*	E
Whale, right	*Eubalaena glacialis*	E
Whale, Sei	*Balaenoptera borealis*	E
Whale, sperm	*Physeter catodon*	E
Wolf, red	*Canis rufus*	E
Birds:		
Crane, whooping	*Grus americana*	E
Eagle, bald	*Haliaeetus leucocephalus*	E
Falcon, American peregrine	*Falco peregrinus anatum*	E
Falcon, Arctic peregrine	*Falco peregrinus tundrius*	E
Pelican, brown	*Pelicanus occidentalis*	E
Warbler, Bachman's	*Vermivora bachmanii*	E
Woodpecker, ivory-billed	*Campephilus principalis*	E
Woodpecker, red-cockaded	*Picoides (=Dendrocopus) borealis*	E
Reptiles:		
Lizards—		
Alligator, American	*Alligator mississippiensis*	T
Turtles—		
Turtle, Atlantic ridley sea	*Lepidochelys kempii*	E
Turtle, green sea	*Chelonia mydas*	T
Turtle, hawksbill sea	*Eretmochelys imbricata*	E
Turtle, leatherback sea	*Dermochelys coriacea*	E
Turtle, loggerhead sea	*Caretta caretta*	T

Table G-9. State-Designated Endangered and Threatened Species—Mississippi

Common name	Scientific name	Status
Mammals:		
All whales of Order Cetacea		E
Bat, gray	*Myotis grisescens*	E
Bat, Indiana	*Myotis sodalis*	E
Bear, black	*Ursus americanus*	E
Manatee, West Indian	*Trichechus manatus*	E
Panther, Florida	*Felis concolor coryi*	E
Birds:		
Crane, Mississippi sandhill	*Grus canadensis pulla*	E
Eagle, bald	*Haliaeetus leucocephalus*	E
Falcon, peregrine	*Falco peregrinus*	E
Pelican, brown	*Pelecanus occidentalis*	E
Plover, piping	*Charadrius melodus*	E
Plover, snowy	*Charadrius alexandrinus*	E
Stork, wood	*Mycteria americana*	E
Tern, least	*Sterna antillarum*	E
Warbler, Bachman's	*Vermivora bachmanii*	E
Woodpecker, ivory-billed	*Campephilus principalis*	E
Woodpecker, red-cockaded	*Picoides borealis*	E
Wren, Bewick's	*Thryomanes bewickii*	E
Reptiles:		
Snakes—		
Snake, black pine	*Pituophis melanoleucus lodingi*	E
Snake, eastern indigo	*Drymarchon corais couperi*	E
Snake, rainbow	*Farancia erytrogramma*	E
Snake, southern hognose	*Heterodon simus*	E
Turtles—		
Tortoise, gopher	*Gopherus polyphemus*	E
Turtle, black-knobbed sawback	*Graptemys nigrinoda*	E
Turtle, green sea	*Chelonia mydas*	E
Turtle, hawksbill sea	*Eretmochelys imbricata*	E
Turtle, Kemp's ridley sea	*Lepidochelys kempii*	E
Turtle, leatherback sea	*Dermochelys coriacea*	E
Turtle, loggerhead sea	*Caretta caretta*	E

Table G-9. State-designated Endangered and Threatened Species—Mississippi (continued)

Common name	Scientific name	Status
Reptiles (continued):		
Turtle, ringed sawback	*Graptemys oculifera*	E
Turtle, yellow-blotched sawback	*Graptemys flavimaculata*	E
Lizards—		
Alligator, American	*Alligator mississippiensis*	T (S/A)
Amphibians:		
Salamanders—		
Salamander, cave	*Eurycea lucifuga*	E
Salamander, green	*Aneides aeneus*	E
Salamander, spring	*Gyrinophilus porphyriticus*	E
Fish:		
Dace, southern redbelly	*Phoxinus erythrogaster*	E
Darter, bayou	*Etheostoma rubrum*	E
Darter, crystal	*Ammocrypta asprella*	E
Madtom, frecklebelly	*Noturus munitus*	E
Sturgeon, Alabama shovelnose	*Scaphirhynchus* sp. cf. *platorynchus*	E
Sturgeon, Atlantic	*Acipenser oxyrhynchus*	E
Mollusks and Crustaceans:		
Clubshell, black	*Pleurobema curtum*	E
Combshell, southern	*Epioblasma penita*	E
Pigtoe, southern pink	*Pleurobema taitianum*	E
Pigtoe, southern round	*Pleurobema marshalli*	E
Stirrup shell	*Quadrula stapes*	E

Note: Mississippi does not have an endangered and threatened plant list.

Table G-10. State-Designated Endangered and Threatened Species—Missouri

Common name	Scientific name	Status
Mammals:		
Bat, gray	*Myotis grisescens*	E
Bat, Indiana	*Myotis sodalis*	E
Bat, Ozark big-eared	*Plecotus townsendii* ssp. *ingens*	E
Bat, small-footed	*Myotis leibii*	R
Bear, black	*Ursus americanus*	R
Jackrabbit, black-tailed	*Lepus californicus*	R
Jackrabbit, white-tailed	*Lepus townsendii*	E
Otter, river	*Lutra canadensis*	R
Rabbit, swamp	*Sylvilagus aquaticus*	R
Weasel, least	*Mustela nivalis*	R
Weasel, long-tailed	*Mustela frenata*	R
Birds:		
Barn-owl, common	*Tyto alba*	E
Bittern, American	*Botaurus lentiginosus*	R
Blackbird, yellow-headed	*Xanthocephalus xanthocephalus*	R
Cormorant, double-crested	*Phalacrocorax auritus*	E
Eagle, bald	*Haliaeetus leucocephalus*	E
Egret, snowy	*Egretta thula*	E
Falcon, peregrine	*Falco peregrinus*	E
Harrier, northern	*Circus cyaneus*	E
Hawk, Cooper's	*Accipiter cooperii*	E
Hawk, red-shouldered	*Buteo lineatus*	R
Hawk, sharp-shinned	*Accipiter striatus*	E
Heron, little blue	*Egretta caerulea*	R
Kite, Mississippi	*Ictinia mississippiensis*	R
Night-heron, black-crowned	*Nycticorax nycticorax*	R
Osprey	*Pandion haliaetus*	E
Prairie-chicken, Attwater's greater	*Tympanuchus cupido attwateri*	R
Rail, king	*Rallus elegans*	E
Sandpiper, upland	*Bartramia longicauda*	R
Sparrow, Bachman's	*Aimophila aestivalis*	E
Sparrow, Henslow's	*Ammodramus henslowii*	R
Swan, trumpeter	*Cygnus buccinator*	E
Tern, interior least	*Sterna antillarum albifrons*	E
Warbler, Swainson's	*Limnothlypis swainsonii*	E

Table G-10. State-Designated Endangered and Threatened Species—Missouri (continued)

Common name	Scientific name	Status
Reptiles:		
Snakes—		
Massasauga, eastern	*Sistrurus catenatus* ssp. *catenatus*	R
Snake, dusty hognose	*Heterodon nasicus* ssp. *gloydi*	E
Snake, green water	*Nerodia cyclopion* ssp. *cyclopion*	R
Snake, plains hognose	*Heterodon nasicus* ssp. *nasicus*	E
Snake, western fox	*Elaphe vulpina* ssp. *vulpina*	E
Snake, western smooth green	*Opheodrys vernalis* ssp. *blanchardi*	
Turtles—		
Turtle, alligator snapping	*Macroclemys temminckii*	R
Turtle, Blanding's	*Emydoidea blandingii*	E
Turtle, Illinois mud	*Kinosternon flavescens* ssp. *spooneri*	E
Turtle, western chicken	*Deirochelys reticularia* ssp. *miaria*	R
Turtle, yellow mud	*Kinosternon flavescens* ssp. *flavescens*	E
Lizards—		
Skink, Great Plains	*Eumeces obsoletus*	R
Amphibians:		
Salamanders—		
Salamander, four-toed	*Hemidactylium scutatum*	R
Salamander, Oklahoma	*Eurycea tynerensis*	R
Frogs and toads—		
Frog, wood	*Rana sylvatica*	R
Fish:		
Bullhead, brown	*Ictalurus nebulosus*	R
Burbot	*Lota lota*	R
Cavefish, Ozark	*Amblyopsis rosae*	E
Cavefish, spring	*Chologaster agassizi*	E
Chub, sicklefin	*Hybopsis meeki*	R
Chub, sturgeon	*Hybopsis gelida*	R
Chubsucker, lake	*Erimyzon sucetta*	R
Darter, bluestrip	*Percina cymatotaenia*	R

Table G-10. State-Designated Endangered and Threatened Species—Missouri (continued)

Common name	Scientific name	Status
Fish (continued):		
Darter, crystal	*Ammocrypta asprella*	E
Darter, goldstripe	*Etheostoma parvipinne*	E
Darter, harlequin	*Etheostoma histrio*	E
Darter, longnose	*Percina nasuta*	R
Darter, Niangua	*Etheostoma nianguae*	R
Darter, redfin	*Etheostoma whipplei*	R
Darter, stargazing	*Percina uranidea*	R
Darter, swamp	*Etheostoma fusiforme*	E
Gar, alligator	*Lepisosteus spatula*	R
Killifish, plains	*Fundulus zebrinus*	R
Lamprey, American brook	*Lampetra appendix*	R
Lamprey, southern brook	*Ichthyomyzon gagei*	R
Madtom, mountain	*Noturus eleutherus*	R
Madtom, Neosho	*Noturus placidus*	E
Minnow, cypress	*Hybognathus hayi*	E
Minnow, eastern slim	*Pimephales tenellus* ssp. *parviceps*	R
Minnow, pugnose	*Notropis emiliae*	E
Mudminnow, central	*Umbra limi*	E
Pumpkinseed	*Lepomis gibbosus*	R
Shad, Alabama	*Alosa alabamae*	R
Shiner, blacknose	*Notropis heterolepis*	E
Shiner, sabine	*Notropis sabinae*	R
Shiner, taillight	*Notropis maculatus*	E
Sturgeon, lake	*Acipenser fulvescens*	E
Sturgeon, pallid	*Scaphiryhnchus albus*	E
Sunfish, bantam	*Lepomis symmetricus*	R
Plants:		
Arrow-wood	*Viburnum recognitum*	E
Arrow-wood, southern	*Viburnum dentatum* var. *deamii*	E
Arrowhead	*Sagittaria ambigua*	E
Arum, arrow	*Peltandra virginica*	R
Aspen, large-toothed	*Populus grandidentata*	R
Aspen, quaking	*Populus tremuloides* var. *tremuloides*	R

Table G-10. State-Designated Endangered and Threatened Species—Missouri (continued)

Common name	Scientific name	Status
Plants (continued):		
Aster, forked	*Aster furcatus*	R
Aster, rice button	*Aster dumosus* var. *strictior*	R
Aster	*Aster brachyactis*	E
Barberry, American	*Berberis canadensis*	E
Bartonia	*Bartonia paniculata*	E
Beak-rush, Harvey's	*Rhynchospora harveyi*	E
Beard-tongue, purple	*Penstemon cobaea* var. *purpureus*	R
Beard-tongue sp.	*Penstemon cobaea* var. *cobaea*	E
Beard-tongue sp.	*Penstemon grandiflorus*	E
Bedstraw, northern	*Galium boreale* var. *hyssopifolium*	E
Beech-drops	*Epifagus virginiana*	R
Bellflower, marsh	*Campanula aparinoides*	E
Bladder-pod	*Lesquerella filiformis*	E
Blite, strawberry	*Chenopodium capitatum*	E
Bluebell, harebell	*Campanula rotundifolia*	E
Broom-rape	*Orobanche ludoviciana*	E
Buckthorn, southern	*Bumelia lycioides*	E
Bugbane, false	*Trautvetteria caroliniensis*	E
Bulrush, Canby's	*Scirpus etuberculatus*	E
Bulrush, Torrey's	*Scirpus torreyi*	E
Burhead	*Echinodorus tenellus* var. *parvulus*	E
Bush, stagger	*Lyonia mariana*	E
Camas, death	*Zigadenus nuttallii*	E
Camas, white	*Zigadenus elegans*	E
Cedar, ground	*Lycopodium tristachyum*	E
Chinquapin, Ozark	*Castanea ozarkensis*	R
Chokeberry, black	*Pyrus melanocarpa*	E
Clover, prairie-	*Petalostemon multiflorum*	E
Clover, running buffalo	*Trifolium stoloniferum*	R
Clover sp.	*Trifolium carolinianum*	E
Clubmoss, fir	*Lycopodium selago* var. *patens*	R
Coneflower, narrow-leafed purple	*Echinacea angustifolia*	E
Corkwood	*Leitneria floridana*	R
Corydalis	*Corydalis halei*	R

Table G-10. State-Designated Endangered and Threatened Species—Missouri (continued)

Common name	Scientific name	Status
Plants (continued):		
Cress, Deam's rock	*Arabis missouriensis* var. *deamii*	E
Crowfoot, seaside	*Ranunculus cymbalaria*	E
Cup, downy painted	*Castilleja sessiliflora*	E
Curls, blue	*Trichostema setaceum*	E
Currant, golden	*Ribes odoratum*	R
Cynosciadium	*Cynosciadium digitatum*	R
Cyperus, many-spiked	*Cyperus polystachyos* var. *texensis*	E
Cyperus, Plukenet's	*Cyperus plukenetii*	R
Cyperus, teasel-like	*Cyperus dipsaciformis*	E
Dalea	*Dalea enneandra*	E
Dandelion, prairie	*Agoseris cuspidata*	E
Dragonhead, false	*Physostegia intermedia*	R
Duckweed, big	*Spirodela oligorhiza*	E
Duckweed, least	*Lemna minima*	R
Duckweed, star	*Lemna trisulca*	R
Elder, red-berried	*Sambucus pubens*	E
Fern, cut-leaved grape	*Botrychium dissectum* var. *tenuifolium*	E
Fern, Goldie's	*Dryopteris goldiana*	R
Fern, hay-scented	*Dennstaedtia punctilobula*	R
Fern, log	*Dryopteris celsa*	E
Fern, netted chain	*Woodwardia areolata*	R
Fern, ostrich	*Matteuccia struthiopteris* var. *pennsylvanica*	R
Fern, spinulose shield	*Dryopteris austriaca* var. *spinulosa*	E
Figwort	*Scrophularia lanceolata*	E
Fleabane	*Erigeron pusillus*	E
Flower, leather	*Clematis viorna* var. *viorna*	R
Flower, monkey	*Mimulus glabratus* var. *fremontii*	E
Frog's-bit, American	*Limnobium spongia*	R
Gentian, yellow-flowered horse	*Triosteum angustifolium* var. *eamesii*	E
Geocarpon	*Geocarpon minimum*	E
Gerardia	*Gerardia heterophylla*	E
Glass, Venus' looking	*Specularia holzingeri*	E
Gourd	*Cayaponia grandifolia*	R
Grass, bayonet	*Scirpus paludosus* var. *paludosus*	E

Table G-10. State-Designated Endangered and Threatened Species—Missouri (continued)

Common name	Scientific name	Status
Plants (continued):		
Grass, blue-eyed	*Sisyrinchium atlanticum*	R
Grass, ditch	*Ruppia maritima* var. *rostrata*	E
Grass, fowl meadow	*Glyceria striata* var. *stricta*	E
Grass, inland salt	*Distichlis stricta*	E
Grass, joint	*Manisuris cylindrica*	E
Grass, pale manna	*Glyceria pallida*	E
Grass, reed bent	*Calamagrostis insperata*	E
Grass, seashore salt	*Distichlis spicata*	E
Grass, spike	*Uniola laxa*	E
Grass, three-awn	*Aristida lanosa*	R
Grass, Whitlow	*Draba aprica*	R
Grass, yellow-eyed	*Xyris torta*	E
Gum, swamp black	*Nyssa sylvatica* var. *sylvatica*	E
Honeysuckle, limber	*Lonicera dioica* var. *dioica*	E
Horse-mint	*Monarda clinopodia*	E
Hydrolea	*Hydrolea ovata*	E
Hyssop, hedge-	*Gratiola viscidula*	E
Hyssop, water-	*Bacopa acuminata*	E
Jointweed	*Polygonella americana*	R
Ladies'-tresses	*Spiranthes ovalis*	R
Lady-slipper, showy	*Cypripedium reginae*	R
Larkspur, tall	*Delphinium exaltatum*	E
Lettuce, blue	*Lactuca pulchella*	E
Lettuce, western	*Lactuca ludoviciana*	E
Lip-fern	*Cheilanthes alabamensis*	R
Lip-fern, woolly	*Cheilanthes tomentosa*	E
Loosestrife, false	*Ludwigia natans*	E
Loosestrife, false	*Ludwigia microcarpa*	E
Loosestrife, swamp	*Decodon verticillatus*	E
Loosestrife, tufted	*Lysimachia thyrsiflora*	E
Love-grass	*Eragrostis glomerata*	E
Love-grass	*Eragrostis reptans*	E
Mallow, Bush's poppy	*Callirhoe papaver* var. *bushii*	R
Mallow, clustered poppy	*Callirhoe triangulata*	R

Table G-10. State-Designated Endangered and Threatened Species—Missouri (continued)

Common name	Scientific name	Status
Plants (continued):		
Marsilea	*Marsilea mucronata*	E
Mermaid, false	*Floerkea proserpinacoides*	R
Milk-vetch, low	*Astragalus lotiflorus*	E
Milkweed, climbing	*Matelea obliqua*	R
Milkweed, Mead's	*Asclepias meadii*	E
Mint, mountain-	*Pycnanthemum torrei* var. *torrei*	E
Mint, mountain-	*Pycnanthemum muticum*	R
Monarda, dotted	*Monarda punctata* var. *occidentalis*	E
Muscadine	*Vitis rotundifolia*	E
Naiad	*Najas gracillima*	E
Nannyberry	*Viburnum lentago*	E
Nettle	*Urtica chamaedryoides*	R
Oak, jack	*Quercus ellipsoidalis*	E
Oak, Nuttall's	*Quercus nuttalli*	E
Oak, poison	*Rhus toxicodendron*	R
Oats, swamp	*Trisetum pensylvanicum*	E
Oldenlandia	*Oldenlandia uniflora*	E
Oldenlandia	*Oldenlandia boscii*	E
Orange, mock	*Philadelphus pubescens* var. *verrucosus*	E
Orchid, green wood	*Habenaria clavellata* var. *clavellata*	E
Orchid, pale green	*Habenaria flava* var. *flava*	E
Orchid, prairie white-fringed	*Habenaria leucophaea*	E
Orchid, snake-mouth	*Pogonia ophioglossoides*	E
Orchid, yellow fringed	*Habenaria ciliaris*	E
Panicgrass	*Panicum calliphyllum*	E
Panicgrass, American	*Panicum columbianum*	E
Panicgrass	*Panicum longiligulatum*	E
Panicgrass, whitehaired	*Panicum villosissimum* var. *pseudopubescens*	E
Paspalum, slender	*Paspalum setaceum* var. *setaceum*	E
Pea, wild	*Lathyrus pusillus*	E
Pennywort	*Obolaria virginica*	E
Pennywort, water-	*Hydrocotyle verticillata* var. *verticillata*	E
Phlox, bifid	*Phlox bifida* var. *stellaria*	R

Table G-10. State-Designated Endangered and Threatened Species—Missouri (continued)

Common name	Scientific name	Status
Plants (continued):		
Phlox, Carolina	*Phlox carolina* var. *angusta*	E
Phyllanthus	*Phyllanthus polygonoides*	E
Pine, round-branched ground	*Lycopodium obscurum* var. *dendroideum*	E
Pink, marsh	*Sabatia brachiata*	E
Plant, umbrella	*Eriogonum longifolium*	E
Plantain, spiny	*Plantago spinulosa*	E
Pogonia, large whorled	*Isotria verticillata*	E
Polypremum	*Polypremum procumbens*	R
Pondberry	*Lindera melissifolium*	E
Pondweed	*Potamogeton epihydrus* var. *nuttallii*	E
Prairie, queen of the	*Filipendula rubra*	E
Primrose, evening-	*Oenothera fruticosa*	R
Primrose, evening-	*Oenothera tetragona*	E
Raspberry, red	*Rubus idaeus* var. *strigosus*	E
Rice, black-seeded mountain	*Oryzopsis racemosa*	E
Robin, Ozark wake	*Trillium pusillum* var. *ozarkanum*	E
Root, Missouri alum	*Heuchera missouriensis*	E
Rush, Baltic	*Juncus balticus*	E
Rush, Canada	*Juncus canadensis* var. *canadensis*	E
Rush, hairy nut	*Scleria ciliata* var. *ciliata*	E
Rush, horsetail spike	*Eleocharis equisetoides*	E
Rush, shining nut	*Scleria nitida*	E
Rush, small spike	*Eleocharis parvula* var. *anachaeta*	E
Rush, swaying	*Scirpus subterminalis*	E
Rush, weak	*Juncus debilis*	E
Rush, wolf's spike	*Eleocharis wolfii*	E
Rye, wild	*Elymus interruptus*	E
Sacaton, alkali	*Sporobolus airoides*	E
Salad, corn	*Valerianella stenocarpa* var. *parviflora*	R
Sarsaparilla, wild	*Aralia nudicaulis*	E
Sedge, awned	*Carex atherodes*	E
Sedge, bellows-beaked	*Carex physorhyncha*	E
Sedge, Cherokee	*Carex cherokeensis*	E
Sedge, field	*Carex conoidea*	E

Table G-10. State-Designated Endangered and Threatened Species—Missouri (continued)

Common name	Scientific name	Status
Plants (continued):		
Sedge, hairy-fruited	*Carex trichocarpa*	R
Sedge, Schweinitz's	*Carex schweinitzii*	E
Sedge, shaved	*Carex tonsa*	E
Sedge	*Carex tetanica*	E
Sedge, straw	*Carex straminea*	E
Sedge, triangular	*Carex triangularis*	E
Sedge, tussock	*Carex stricta* var. *strictior*	R
Sedge, water	*Carex aquatilis*	E
Sedge, white-edge	*Carex debilis* var. *debilis*	E
Sedge, Wood's	*Carex woodii*	E
Sida	*Sida elliottii*	E
Skeletonplant	*Lygodesmia juncea*	E
Skullcap	*Scutellaria serrata* var. *montana*	E
Smartweed	*Polygonum densiflorum*	R
Snakeroot, button	*Liatris spicata*	E
Soapberry	*Sapindus drummondii*	R
Soapweed	*Yucca glauca* var. *glauca*	E
Soapweed	*Yucca glauca* var. *mollis*	R
Spermolepis, rough-fruited	*Spermolepis divaricata*	E
Spurge	*Euphorbia geyeri*	E
St. John's-wort	*Hypericum canadense* var. *canadense*	E
Star, amethyst shooting	*Dodecatheon amethystinum*	R
Star, blazing	*Liatris mucronata*	R
Star, ciliate blue	*Amsonia ciliata*	E
Starwort	*Boltonia asteroides* var. *decurrens*	E
Stenosiphon	*Stenosiphon linifolius*	E
Strawberry, barren	*Waldsteinia fragarioides*	E
Sullivantia	*Sullivantia renifolia*	R
Tear, halberd-leaved	*Polygonum arifolium* var. *pubescens*	E
Thalia	*Thalia dealbata*	R
Thelesperma	*Thelesperma trifidum*	E
Thimbleweed	*Anemone cylindrica*	R
Thoroughwort, hyssop-leaved	*Eupatorium hyssopifolium* var. *calcaratum*	E

Table G-10. State-Designated Endangered and Threatened Species—Missouri (continued)

Common name	Scientific name	Status
Plants (continued):		
Tree, fringe	*Chionanthus virginica*	R
Trefoil, tick	*Desmodium strictum*	E
Turtlehead, rose	*Chelone obliqua* var. *speciosa*	E
Twayblade, Loesel's	*Liparis loeselii*	E
Vetch	*Vicia ludoviciana* var. *ludoviciana*	E
Violet, smooth white	*Viola pallens*	E
Water-meal	*Wolffia punctata*	R
Waterwort	*Elatine triandra* var. *americana*	E
Weed, bugle	*Lycopus asper*	E
Weed, loco	*Oxytropis lambertii*	E
William, wild sweet	*Phlox maculata* var. *pyramidalis*	E
Willow, primrose-	*Jussiaea leptocarpa* var. *leptocarpa*	E
Winterberry	*Ilex verticillata* var. *padifolia*	R
Witch-grass, wood	*Panicum philadelphicum* var. *tuckermani*	E
Wolfberry	*Symphoricarpos occidentalis*	E
Wood, yellow	*Cladrastis lutea*	R

Table G-11. State-Designated Endangered and Threatened Species—New Mexico

Common name	Scientific name	Status
Mammals:		
Bat, southern yellow	*Nycteris ega*	T
Bat, spotted	*Euderma maculata*	T
Chipmunk, Colorado	*Eutamias quadrivittatus australis*	T
Chipmunk, least	*Eutamias minimus atristriatus*	E
Gopher, southern pocket	*Thomomys umbrinus emotus*	T
Jackrabbit, white-sided	*Lepus callotis*	E
Marten, pine	*Martes americana*	T
Mouse, meadow jumping	*Zapus hudsonius luteus*	T
Sheep, bighorn	*Ovis canadensis mexicana*	E
Shrew, Arizona	*Sorex arizonae*	E
Shrew, least	*Cryptotis parva*	T
Vole, montane	*Microtus montanus arizonensis*	T
Wolf, gray	*Canis lupus baileyi*	E
Birds:		
Black-hawk, common	*Buteogallus anthracinus*	T
Bunting, varied	*Passerina versicolor*	T
Cormorant, olivaceous	*Phalacrocorax olivaceus*	T
Crane, whooping	*Grus americana*	T
Eagle, bald	*Haliaeetus leucocephalus*	T
Falcon, peregrine	*Falco peregrinus*	E
Ground-dove, common	*Columbina passerina*	E
Hummingbird, broad-billed	*Cynanthus latirostris*	T
Hummingbird, Costa's	*Calypte costae*	T
Hummingbird, Lucifer	*Calothorax lucifer*	T
Hummingbird, violet-crowned	*Amazilia violiceps*	T
Hummingbird, white-eared	*Hylocharis leucotis*	T
Junco, yellow-eyed	*Junco phaeonotus*	T
Kingbird, thick-billed	*Tyrannus crassirostris*	T
Kite, Mississippi	*Ictinia mississippiensis*	T
Nightjar, buff-collared	*Caprimulgus ridgwayi*	E
Pelican, brown	*Pelecanus occidentalis*	T
Plover, piping	*Charadrius melodus*	T
Ptarmigan, white-tailed	*Lagopus leucurus*	E
Sparrow, Baird's	*Ammodramus bairdii*	T

Table G-11. State-Designated Endangered and Threatened Species—New Mexico (continued)

Common name	Scientific name	Status
Birds (continued):		
Tern, least	*Sterna antillarum athalassos*	E
Towhee, Abert's	*Pipilo aberti*	T
Trogon, elegant	*Trogon elegans*	E
Turkey, wild	*Meleagris gallopavo mexicana*	T
Tyrannulet, northern beardless	*Campostoma imberbe*	E
Vireo, least Bell's	*Vireo bellii pusillus*	T
Vireo, gray	*Vireo vicinior*	T
Woodpecker, Gila	*Melanerpes uropygialis*	T
Reptiles:		
Snakes—		
Rattlesnake, New Mexican ridge-nosed	*Crotalus willardi obscurus*	E
Rattlesnake, rock	*Crotalus lepidus lepidus*	T
Snake, green rat	*Senticolis triaspis*	T
Snake, Mexican garter	*Thamnophis eques*	E
Snake, narrowhead garter	*Thamnophis rufipunctatus*	T
Snake, plainbelly water	*Nerodia erythrogaster*	T
Snake, western ribbon	*Thamnophis proximus*	T
Turtles—		
Cooter, river	*Pseudemys concinna*	T
Lizards—		
Lizard, bunch grass	*Sceloporus scalaris*	
Lizard, sagebrush	*Sceloporus graciosus arenicolous*	T
Monster, Gila	*Heloderma suspectum*	E
Skink, mountain	*Eumeces callicephalus*	T
Whiptail, giant spotted	*Cnemidophorus burti*	T
Whiptail, gray-checkered	*Cnemidophorus dixoni*	T
Amphibians:		
Salamanders—		
Salamander, Jemez Mountains	*Plethodon neomexicanus*	T
Salamander, Sacramento Mountain	*Aneides hardii*	T

Table G-11. State-Designated Endangered and Threatened Species—New Mexico (continued)

Common name	Scientific name	Status
Amphibians (continued):		
Frogs and toads—		
Frog, lowland leopard	*Rana yavapaiensis*	E
Toad, Colorado River	*Bufo alvarius*	T
Toad, Great Plains narrowmouth	*Gastrophryne olivacea*	E
Toad, western	*Bufo boreas*	T
Fish:		
Chub, Chihuahua	*Gila nigrescens*	E
Chub, Gila	*Gila intermedia*	E
Chub, roundtail	*Gila robusta*	T
Chub, speckled	*Hypobsis aestivalis tetranemus*	T
Dace, southern redbelly	*Phoxinus erythrogaster*	E
Darter, greenthroat	*Etheostoma lepidum*	T
Gambusia, Pecos	*Gambusia nobilis*	T
Logperch, bigscale	*Percina macrolepida*	T
Minnow, loach	*Tiaroga cobitis*	T
Minnow, Rio Grande silvery	*Hybognathus amarus*	T
Minnow, suckermouth	*Phenacobius mirabilis*	T
Pupfish, Pecos	*Cyprinodon pecosensis*	T
Pupfish, White Sands	*Cyprinodon tularosa*	T
Redhorse, gray	*Moxostoma congestum*	T
Shiner, Arkansas River	*Notropis girardi*	E
Shiner, bluntnose	*Notropis simus simus*	E
Shiner, Pecos bluntnose	*Notropis simus pecosensis*	T
Shiner, phantom	*Notropis orca*	E
Spikedace	*Meda fulgida*	T
Squawfish, Colorado	*Ptychocheilus lucius*	E
Stickleback, brook	*Culaea inconstans*	T
Sucker, blue	*Cycleptus elongatus*	E
Sucker, bluehead	*Catostomus discobolus yarrowi*	T
Tetra, Mexican	*Astyanax mexicanus*	T
Trout, Gila	*Oncorhynchus (=Salmo) gilae*	T

Table G-11. State-Designated Endangered and Threatened Species—New Mexico (continued)

Common name	Scientific name	Status
Mollusks:		
Assiminea, Pecos	*Assiminea pecos*	E
Mussel, papershell	*Anodonta imbecillis*	E
Mussel, Pope's	*Popenaias popei*	E
Pea-clam, circular	*Musculium partumeium*	T
Pea-clam, Lilljeborg's	*Pisidium lilljeborgii*	T
Pea-clam, Raymond's	*Musculium raymondi*	T
Pea-clam, Sangre de Cristo	*Pisidium sanguinichristi*	T
Pea-clam, wide	*Musculium transversum*	T
Snail, Alamosa Spring	*Tryonia alamosae*	T
Snail, Chupadera Spring	*Fontelicella chupaderae*	T
Snail, Gila Spring	*Fontelicella gilae*	T
Snail, Koster's Spring	*Tryonia kosteri*	T
Snail, Linnaeus' ramshorn	*Gyraulus crista*	T
Snail, New Mexico Hot Spring	*Fontelicella thermalis*	T
Snail, Pecos Spring	*Fontelicella pecosensis*	T
Snail, Roswell Spring	*Fontelicella roswellensis*	E
Snail, Say's Pond	*Lymnaea caperata*	E
Snail, Socorro Spring	*Fontelicella neomexicana*	E
Crustaceans:		
Amphipod, Noel's	*Gammarus desperatus*	T
Isopod, Socorro	*Thermosphaeroma (=Exosphaeroma) thermophilum*	E
Plants[a]:		
Barrel, small-flowered devil's claw	*Sclerocactus parviflora*	E
Barrel, Whipple's devil's claw	*Sclerocactus whipplei*	E
Bean, Guadalupe Mountain mescal	*Sophora gypsophila* var. *guadalupenis*	E
Buckwheat, gypsum	*Eriogonum gypsophilum*	E
Buckwheat, woolly	*Eriogonum densum*	E
Cactus, button	*Epithelantha micromeris*	E
Cactus, Duncan's pincushion	*Coryphantha duncanii*	E
Cactus, grama grass	*Toumeya papyracantha*	E
Cactus, green-flowered fish-hook	*Mammillaria viridiflora*	E
Cactus, Knowlton	*Pediocactus knowltonii*	E

Table G-11. State-Designated Endangered and Threatened Species—New Mexico (continued)

Common name	Scientific name	Status
Plants[a] (continued):		
Cactus, Kuenzler hedgehog	*Echinocereus kuenzleri*	E
Cactus, Lee pincushion	*Coryphantha sneedii* var. *leei*	E
Cactus, Lloyd's hedgehog	*Echinocereus lloydii*	E
Cactus, Mesa Verde	*Sclerocactus mesae-verdae*	E
Cactus, Orcutt's pincushion	*Escobaria orcuttii*	E
Cactus, Organ Mountains pincushion	*Coryphantha organesis*	E
Cactus, Sandberg's pincushion	*Escobaria sandbergii*	E
Cactus, Scheer's pincushion	*Coryphantha scheeri*	E
Cactus, Sneed pincushion	*Coryphantha sneedii* var. *sneedii*	E
Cactus, Villard's pincushion	*Escobaria villardii*	E
Cactus, Wright fishhook	*Mammillaria wrightii*	E
Candilla	*Euphorbia antisyphilitica*	E
Cereus, night-blooming	*Cereus greggii*	E
Cholla, green-flowered	*Opuntia viridiflora*	E
Cinquefoil, White Mountains	*Potentilla sierrae-blancae*	E
Clubmoss	*Lycopodium annotinum*	E
Columbine, Chaplin's	*Aquilegia chaplinii*	E
Coral-root, crested	*Hexalectris nitida*	E
Coral-root, crested	*Hexalectris spicata*	E
Daisy, Hershey's cliff	*Chaetopappa hersheyi*	E
Daisy, nodding cliff	*Perityle cernua*	E
Daisy, Sierra Blanca cliff	*Chaetopappa elegans*	E
Figwort, Mimbres	*Scrophularia macrantha*	E
Fleabane, Hess's	*Erigeron hessii*	E
Flower, Long-stemmed flame	*Talinum longipes*	E
Flower, Pinos Altos flame	*Talinum humile*	E
Gilia, Aztec	*Gilia formosa*	E
Globemallow, Porter's	*Sphaeralcea procera*	E
Goldenweed, small-headed	*Happlopappus microcephalus*	E
Groundsel, Gila	*Senecio quaerens*	E
Ladies'-tresses	*Spiranthes parasitica*	E
Ladies'-tresses	*Spiranthes magnicamporum*	E
Lady-slipper, golden	*Cypripedium calceolus* var. *pubescens*	E
Lily, checker	*Fritillaria atropurpurea*	E

Table G-11. State-Designated Endangered and Threatened Species—New Mexico (continued)

Common name	Scientific name	Status
Plants[a] (continued):		
Lily, mountain	*Lilium philadelphicum*	E
Milk-vetch, gypsum	*Astragalus gypsodes*	E
Milk-vetch, Mancos	*Astragalus humillimus*	E
Milkwort, Guadalupe	*Polygala rimulicola*	E
Mouth, Adder's	*Malaxis tenuis*	E
Onion, Goodding's	*Allium gooddingii*	E
Orchid, bog	*Habenaria dilatata* var. *dilatata*	E
Pear, sand prickly	*Opuntia arenaria*	E
Pennyroyal, McKittrick	*Hedeoma apiculatum*	E
Pennyroyal, Todsen's	*Hedeoma todsenii*	E
Penstemon, Alamo	*Penstemon alamosensis*	E
Plant, dune unicorn	*Proboscidea sabulosa*	E
Prickle-poppy, Sacramento	*Argemone pleicantha* ssp. *pinnatisecta*	E
Rosewood, few-flowered	*Vauguelinia pauciflora*	E
Saltbrush, succulent dwarf	*Atriplex pleiantha*	E
Scalebroom, gypsum	*Lepidospartum burgesii*	E
Sibara, gray	*Sibara grisea*	E
Spider-flower, slender	*Cleome multicaulis*	E
Thistle, Mescalero	*Cirsium vinaceum*	E
Visnaguita, white-flowered	*Neolloydia intertexta*	E

[a] As of October 28, 1985.

Table G-12. State-Designated Endangered and Threatened Species—Oklahoma

Common name	Scientific name	Status
Mammals:		
Bat, gray	*Myotis grisescens*	E
Bat, Indiana	*Myotis sodalis*	E
Bat, Ozark big-eared	*Plecotus townsendii ingens*	E
Ferret, black-footed	*Mustela nigripes*	E
Birds:		
Crane, whooping	*Grus americana*	E
Eagle, bald	*Haliaeetus leucocephalus*	E
Falcon, American peregrine	*Falco peregrinus anatum*	E
Plover, piping	*Charadrius melodus*	T
Tern, least	*Sterna antillarum*	E
Vireo, black-capped	*Vireo atricapillus*	E
Woodpecker, red-cockaded	*Picoides (=Dendrocopus) borealis*	E
Reptiles:		
Lizards—		
Alligator, American	*Alligator mississippiensis*	T
Fish:		
Cavefish, Ozark	*Amblyopsis rosae*	E
Darter, leopard	*Percina pantherina*	E
Darter, longnose	*Etheostoma cragini*	E
Madtom, Neosho	*Noturus placidus*	E
Mollusks:		
Mussel, Wheeler's	*Arkansia wheeleri arcidens*	E

Table G-13. State-Designated Endangered and Threatened Species—South Carolina

Common name	Scientific name	Status
Mammals:		
Bat, Indiana	*Myotis sodalis*	E
Cougar, eastern	*Felis concolor cougar*	E
Manatee, West Indian	*Trichechus manatus*	E
Whale, right	*Eubalaena glacialis*	E
Whale, blue	*Balaenoptera musculus*	E
Whale, bowhead	*Balaena mysticetus*	E
Whale, finback	*Balaenoptera physalus*	E
Whale, humpback	*Megatera novaeangliae*	E
Whale, sei	*Balaenoptera borealis*	E
Whale, sperm	*Physeter catodon*	E
Birds:		
Curlew, Eskimo	*Numenius borealis*	E
Eagle, bald	*Haliaeetus leucocephalus*	E
Eagle, golden	*Aquila chrysaetos*	E
Falcon, American peregrine	*Falco peregrinus anatum*	E
Falcon, Arctic peregrine	*Falco peregrinus tundrius*	E
Kite, swallow-tailed	*Elanoides forficatus*	E
Pelican, brown	*Pelecanus occidentalis*	T
Sparrow, Ipswich	*Passerculus sandwichensis princeps*	E
Stork, wood	*Mycteria americana*	E
Tern, least	*Sterna antillarum*	T
Warbler, Bachman's	*Verminora bachmanii*	E
Warbler, Kirtland's	*Dendroica kirtlandii*	E
Woodpecker, ivory-billed	*Campephilus principalis*	E
Woodpecker, red-cockaded	*Picoides (=Dendrocopus) borealis*	E
Reptiles:		
Snakes—		
Snake, eastern indigo	*Drymarchon corias couperi*	E
Turtles—		
Tortoise, gopher	*Gopherus polyphemus*	E
Turtle, green sea	*Chelonia mydas*	T
Turtle, hawksbill sea	*Eretmochelys imbricata*	E

Table G-13. State-Designated Endangered and Threatened Species—South Carolina (continued)

Common name	Scientific name	Status
Reptiles (continued):		
Turtle, Kemp's ridley sea	*Lepidochelys kempii*	E
Turtle, leatherback sea	*Dermochelys coriacea*	E
Turtle, loggerhead sea	*Caretta caretta*	T
Lizards—		
Skink, coal	*Eumeces anthracinus*	T
Amphibians:		
Salamander—		
Salamander, Webster's	*Plethodon websteri*	E
Frog—		
Tree Frog, Pine Barrens	*Hyla andersoni*	T
Fish:		
Chub, sandhills	*Semotilus lumbee*	T
Darter, Carolina	*Ethiostoma collis collis*	T
Sturgeon, shortnose	*Acipenser brevirostrum*	E
Gastropods:		
Mussel, brother spike	*Elliptio fraterna*	E
Pigtoe, Atlantic	*Fusconaia masoni*	E
Plants:[a]		
Allegheny-spurge	*Pachysandra procumbens*	E
Arrow-head, bunched	*Sagittaria fasciculata*	E
Aster, Alexander's rock	*Aster avitus*	E
Azalea, Oconee	*Rhododendron flammeum*	T
Bachelor's button	*Polygala nana*	T
Bantam-buttons	*Syngonanthus flavidulus*	T
Barren strawberry	*Waldsteinia lobata*	T
Beak-rush, white	*Rhynchospora alba*	T
Bellflower, tall	*Campanula americana*	T
Bells, Oconee	*Shortia galacifolia*	T

Table G-13. State-Designated Endangered and Threatened Species—South Carolina (continued)

Common name	Scientific name	Status
Plants[a] (continued):		
Birch, yellow	*Betula alleghaniensis*	T
Bishop-weed, mock	*Ptlimnium nodosum*	E
Bladderwort, dwarf	*Utricularia olivacea*	T
Bladderwort, Florida	*Utricularia floridana*	T
Breweria, Pickering's	*Stylisma pickeringii*	T
Buckeye, bottlebrush	*Aesculus parviflora*	T
Burdock, prairie	*Silphium terebinthinaceum*	T
Burhead, little	*Echinodorus tenellus* var. *parvulus*	T
Burning bush	*Euonymus atropurpureus*	T
Chaffseed	*Schwalbea americana*	T
Clubmoss, rock-loving	*Lycopodium porophilum*	T
Cohosh, blue	*Caulophyllum thalictroides*	T
Columbo	*Frasera caroliniensis*	T
Coneflower, smooth	*Echinacea laevigata*	T
Coneflower, soft-haired	*Rudbeckia mollis*	T
Coneflower, sun-facing	*Rudbeckia heliopsidis*	T
Cowbane, Canby's	*Oxypolis canbyi*	T
Daisy, confederate	*Viguiera porteri*	E
Dicerandra, rose	*Dicerandra odoratissima*	T
Dogwood, gray-stemmed	*Cornus foemina* ssp. *racemosa*	T
Dropwort, Canby's	*Oxypolis canbyi*	T
Dutchman's breeches	*Dicentra cucularia*	T
Dutchman's pipe	*Aristolochia macrophylla*	T
Enchanter's nightshade	*Circaea lutetiana* ssp. *canadensis*	T
Fern, Appalachian filmy	*Trichomanes boschianum*	T
Fern, Bradley's spleenwort	*Asplenium bradleyi*	E
Fern, bristle	*Trichomanes boschianum*	T
Fern, Carolina spleenwort	*Asplenium heteroresiliens*	E
Fern, climbing	*Lygodium palmatum*	T
Fern, dwarf filmy	*Trichomanes petersii*	T
Fern, glade	*Diplasium pycnocarpum*	T
Fern, Goldie's	*Dryopteris goldiana*	E
Fern, little ebony spleenwort	*Asplenium resiliens*	T
Fern, narrow-leaved	*Diplasium pycnocarpon*	T

Table G-13. State-Designated Endangered and Threatened Species—South Carolina (continued)

Common name	Scientific name	Status
Plants[a] (continued):		
Fern, pinnatifid spleenwort	*Asplenium pinnatifidum*	T
Fern, purple cliff-brake	*Pellaea atropurpurea*	T
Fern, single-sorus spleenwort	*Asplenium monanthes*	E
Fern, Tunbridge	*Hymenophyllum tunbridgense*	E
Fern, walking	*Asplenium rhizophyllum*	T
Fetterbush, climbing	*Pieris phillyreifolia*	T
Fever-bark, Georgia	*Pinckneya pubens*	T
Fimbry, dwarf	*Fimbristylis perpusilla*	T
Flatsedge	*Cyperus distinctus*	T
Flatsedge	*Cyperus tetragonus*	T
Flytrap, Venus	*Dionaea muscipula*	T
Gentian, Plymouth	*Sabatia kennedyana*	E
Ginseng	*Panax quinquefolius*	T
Golden heather	*Hudsonia ericoides*	T
Goldenrod, spring-flowering	*Solidago verna*	T
Goldenrod, white-flowered	*Solidago bicolor*	T
Goldenrod, woody	*Chrysoma pauciflosculosa*	T
Gooseberry, Miccosukee	*Ribes echinellum*	T
Gopher Apples	*Licania michauxii*	T
Grass-of-Parnassus, Carolina	*Parnassia caroliniana*	T
Grass-of-Parnassus, kidney-leaved	*Parnassia asarifolia*	T
Grass-of-Parnassus, large-leaved	*Parnassia grandifolia*	T
Gromwell, tuberous	*Lithospermum tuberosum*	T
Groovebur, incised	*Agrimonia incisa*	T
Ground-cedar	*Lycopodium tristachyum*	T
Ground-pine	*Lycopodium tristachyum*	T
Groundsel, divided-leaved	*Senecio millefolium*	T
Heartleaf, dwarf-flowered	*Hexastylis naniflora*	E
Hedge-nettle, broad-toothed	*Stachys clingmanii*	T
Hedge-nettle, broad-toothed	*Stachys tennifelia* var. *latidens*	T
Hemicarpha sp.	*Hemicarpha micrantha*	T
Hickory, nutmeg	*Carya myristicaeformis*	T
Honeysuckle, yellow	*Lonicera canadense*	T

Table G-13. State-Designated Endangered and Threatened Species—South Carolina (continued)

Common name	Scientific name	Status
Plants[a] (continued):		
Horse-mint, mountain	*Pycnanthemum montanum*	T
Huckleberry, Rayner's	*Vaccinium sempervirens*	E
Hyacinth, wild	*Camassia scilloides*	T
Indigobush, Schwerin's	*Amorpha schwerinii*	T
Jove's fruit	*Lindera melissaefolium*	E
Juniper, ground	*Juniperus communis* var. *depressa*	T
Ladies'-tresses, long-lip	*Spiranthes longilabris*	T
Lilaeopsis, Carolina	*Lilaeopsis carolinensis*	T
Lily, Canada or wild yellow	*Lilium canadense*	T
Lily of the valley, wild	*Convallaria montana*	T
Loosestrife, Fraser's	*Lysimachia fraseri*	T
Loosestrife, rough-leaved	*Lysimachia asperulaefolia*	E
Magnolia vine	*Schisandra glabra*	T
Maple, striped	*Acer pensylvanicum*	T
Milkweed, savanna or stalked	*Asclepias pedicellata*	T
Milkwort, dwarf	*Polygala nana*	T
Milkwort, fringed	*Polygala paucifolia*	T
Mock-orange	*Philadelphus hirsutus*	T
Monkshood, wild	*Aconitum uncinatum*	T
Morning-glory	*Ipomoea macrorhiza*	T
Mountain-camelia	*Stewartia ovata*	T
Nut-rush, Baldwin's	*Scleria baldwinii*	T
Oak, Durand's white	*Quercus durandii*	T
Oak, swamp white	*Quercus bicolor*	T
Orchid, bog-rose	*Arethusa bulbosa*	T
Orchid, giant spiral	*Spiranthes longilabris*	T
Orchid, green-fringed	*Platanthera lacera*	T
Orchid, purple fringeless	*Platanthera peramoena*	E
Orchid, three-birds	*Triphora trianthophora*	T
Orchid, white fringeless	*Platanthera integrilabia*	E
Orpine, Puck's	*Sedum pusillum*	T
Paintbrush, scarlet Indian	*Castilleja coccinea*	T
Pigweed, sea-beach	*Amaranthus pumilis*	T
Pinckneya	*Pinckneya pubens*	T

Table G-13. State-Designated Endangered and Threatened Species—South Carolina (continued)

Common name	Scientific name	Status
Plants[a] (continued):		
Pinesap, sweet	*Monotropsis odorata*	T
Pink, swamp	*Helonias bullata*	E
Pitcher-plant, mountain sweet	*Sarracenia jonesii*	E
Pogonia, nodding	*Triphora trianthophora*	T
Pogonia, small whorled	*Isotria medeoloides*	E
Pondweed, conferva	*Potamogeton confervoides*	T
Privet	*Forestiera segregata*	T
Purslane, crowned	*Portulaca umbraticola*	T
Pyxie-moss	*Pyxidanthera barbulata*	T
Pyxie-moss, sandhill	*Pyxidanthera barbulata* ssp. *brevifolia*	E
Queen's-delight (or root)	*Stillingia aquatica*	E
Quillwort, Piedmont	*Isoetes piedmontana*	T
Rock-cress	*Arabis missouriensis*	T
Rue-anemone, false	*Isopyrum biternatum*	T
Sandwort, Godfrey's	*Arenaria godfreyi*	T
Saxifrage, brook	*Boykinia acontifolia*	T
Saxifrage, Carey's	*Saxifraga careyana*	T
Saxifrage, golden	*Chrysosplenium americanum*	T
Scorpion-weed	*Phacelia bipinnatifida*	T
Sedge, Biltmore	*Carex biltmoreana*	T
Sedge, Chapman's	*Carex chapmanii*	T
Sedge, Collins'	*Carex collinsii*	T
Sedge, long	*Carex folliculata*	E
Sedge	*Carex brunnescens*	T
Shoe-buttons	*Synagonanthus flavidulus*	T
Shortia	*Shortia galacifolia*	T
Silverrod	*Solidago bicolor*	T
Silver-bell, two-winged	*Halesia diptera*	T
Snakeroot, black	*Sanicula trifoliata*	T
Sneezeweed	*Helenium brevifolium*	E
Spicebush, southern	*Lindera melissaefolium*	E
Spider-lily, Rocky Shoals	*Hymenocallis coronaria*	T
Sprite, pool	*Amphianthus pusillus*	T
St. John's-wort, creeping	*Hypericum adpressum*	T

Table G-13. State-Designated Endangered and Threatened Species—South Carolina (continued)

Common name	Scientific name	Status
Plants[a] (continued):		
Staggerbush	*Lyonia ferruginea*	T
Star-vine, bay or smooth	*Schisandra glabra*	T
Sunflower, Schweinitz'	*Helianthus schweinitzii*	T
Sunnybell	*Schoenolirion croceum*	E
Swamp-potato, quill-leaved	*Sagittaria isoetiformis*	T
Sweet fern	*Comptonia peregrina*	T
Teaberry	*Gaultheria procumbens*	T
Thimbleweed, Carolina	*Anemone caroliniana*	T
Tickseed, broad-leaved	*Coreopsis latifolia*	E
Tickseed, pink	*Coreopsis rosea*	T
Trillium, Carolina	*Trillium pusillum*	T
Trillium, lance-leaved	*Trillium lancifolium*	T
Trillium, persistent	*Trillium persistens*	E
Trillium, relict	*Trillium reliquum*	E
Turkeybeard	*Xerophyllum asphodeloides*	T
Umbrella-leaf	*Diphylleia cymosa*	E
Wahoo	*Euonymus atropurpureus*	T
Water-hyssop	*Bacopa cyclophylla*	T
Water-milfoil, loose	*Myriophyllum laxum*	T
Waterleaf	*Hydrophyllum canadense*	T
Whiskfern	*Psilotum nudum*	E
Whitlow-wort	*Draba aprica*	E
Wicky, white	*Kalmia cuneata*	E
Windflower, Carolina	*Anemone caroliniana*	T
Wintergreen	*Gaultheria procumbens*	T
Witch-alder, Appalachian	*Fothergilla major*	T
Wood-oread	*Magnolia pyramidata*	T
Yellow-wood	*Cladrastis kentuckea*	T

[a] As of 1985.

Table G-14. State-Designated Endangered and Threatened Species—Tennessee

Common name	Scientific name	Status
Mammals:		
Bat, gray	*Myotis grisescens*	E
Bat, Indiana	*Myotis sodalis*	E
Cougar, eastern	*Felix concolor cougar*	E
Otter, river	*Lutra canadensis*	T
Squirrel, Carolina northern flying	*Glaucomys sabrinus coloratus*	E
Birds:		
Eagle, bald	*Haliaeetus leucocephalus*	E
Eagle, golden	*Aquila chrysaetos*	E
Falcon, peregrine	*Falco peregrinus*	E
Harrier, northern (marsh hawk)	*Circus cyaneus*	T
Hawk, Cooper's	*Accipiter cooperii*	T
Hawk, sharp-shinned	*Accipiter striatus*	T
Kite, Mississippi	*Ictinia mississippiensis*	E
Osprey	*Pandion haliaetus*	E
Raven, common	*Corvus corax*	E
Sparrow, Bachman's	*Aimophila aestivalis*	E
Sparrow, grasshopper	*Ammodramus savannarum*	T
Tern, interior least	*Sterna antillarum*	E
Woodpecker, red-cockaded	*Picoides borealis*	E
Wren, Bewick's	*Thryomanes bewickii*	T
Reptiles:		
Snakes—		
Rattlesnake, western pigmy	*Sistrurus miliarius streckeri*	T
Snake, northern pine	*Pituophis m. melanoleucus*	T
Amphibians:		
Salamanders—		
Salamander, Tennessee cave	*Gyrinophilus palleucus*	T
Fish:		
Chub, slender	*Hybopsis cahni*	T
Chub, spotfin	*Hybopsis monacha*	E

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Fish (continued):		
Darter, amber	*Percina antesella*	E
Darter, coldwater	*Etheostoma ditrema*	T
Darter, coppercheek	*Etheostoma aquali* (cf. *Etheostoma maculatum*)	T
Darter, duskytail	*Etheostoma* (*Catonotus*) sp.	T
Darter, longhead	*Percina macrocephala*	T
Darter, slackwater	*Etheostoma boschungi*	T
Darter, snail	*Percina tanasi*	T
Darter, trispot	*Etheostoma trisella*	T
Darter, Tuckasegee	*Etheostoma blennoides gutselli*	E
Darter, western sand	*Ammocrpta clara*	T
Logperch, Conasauga (reticulate)	*Percina jenkinsi*	E
Madtom, frecklebelly	*Noturus munitus*	T
Madtom, pygmy	*Noturus stanauli*	E
Madtom, smoky	*Noturus baileyi*	E
Madtom, yellowfin	*Noturus flavipinnis*	E
Minnow, silverjaw	*Ericymba buccata*	T
Muskellunge, Ohio River (in Morgan, Cumberland, Fentress, & Scott Counties)	*Esox masquinongy ohioensis*	E
Sturgeon, lake	*Acipenser fulvescens*	E
Sucker, blue	*Cycleptus elongatus*	T
Topminnow, barrens	*Fundulus julisia* (cf. *Fundulus albolineatus*)	T
Mollusks:		
Pearly mussel, Alabama lamp	*Lampsilis virescens*	E
Pearly mussel, Appalachian monkeyface	*Quadrula sparsa*	E
Pearly mussel, birdwing	*Conradilla caelata*	E
Pearly mussel, Cumberland bean	*Villosa trabalis* var. *perpurpurea*	E
Pearly mussel, Cumberland monkeyface	*Quadrula intermedia*	E
Pearly mussel, dromedary	*Dromus dromas*	E
Pearly mussel, green-blossom	*Epioblasma* (=*Dysnomia*) *torulosa gubernaculum*	E
Pearly mussel, pale lilliput	*Toxolasma* (=*Carunculina*) *cylindrella*	E

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Mollusks (continued):		
Pearly mussel, (=pimpleback), orange-footed	*Plethobasus cooperianus*	E
Pearly mussel, pink mucket	*Lampsilis orbiculata orbiculata*	E
Pearly mussel, tuberculed-blossom	*Epioblasma (=Dysnomia) torulosa torulosa*	E
Pearly mussel, turgid-blossom	*Epioblasma (=Dysnomia) turgidula*	E
Pearly mussel, white warty-back	*Plethobasus cicatricosus*	E
Pearly mussel, yellow-blossom	*Epioblasma (=Dysnomia) florentina florentina*	E
Pigtoe, fine-rayed	*Fusconaia cuneolus*	E
Pigtoe, rough	*Pleurobema plenum*	E
Pigtoe, shiny	*Fusconaia edgariana*	E
Riffle shell, tan	*Epioblasma (=Dysnomia) walkeri*	E
Snail, Chittenango ovate amber	*Succinea chittenangoensis*	T
Snail, painted snake coiled forest	*Anguispira picta*	E
Crustaceans:		
Crayfish, Nashville	*Orconectes shoupi*	E
Plants:		
Adder's-tongue, bulbous	*Ophioglossum crotalophoroides*	S
Alder, green	*Alnus crispa*	S
Alumroot, maple-leaf	*Heuchera longiflora* var. *aceroides*	S
Anemone, Canada	*Anemone canadensis*	E-P
Anemone, Carolina	*Anemone caroliniana*	E
Panicgrass, gibbous	*Sacciolepis striata*	S
Arrowhead, grassleaf	*Sagittaria graminea* var. *graminea*	T
Arrowhead, ovate-leaved	*Sagittaria platyphylla*	S
Arrowhead, short-beaked	*Sagittaria brevirostra*	T
Arrowwood sp.	*Viburnum bracteatum*	E
Aster, Ruth's golden	*Pityopsis ruthii*	E
Aster, western silvery	*Aster sericeus*	T
Aster, white heath	*Aster ericoides*	T
Aster, willow	*Aster praealtus*	E-P

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Plants (continued):		
Avens, bent	*Geum geniculatum*	E
Avens, spreading	*Geum radiatum*	E
Barbara's-buttons, broadleaf	*Marshallia trinervia*	T
Barbara's-buttons, large-flowered	*Marshallia grandiflora*	E
Beakrush, capillary	*Rhynchospora capillacea*	E-P
Beakrush, few-flowered	*Rhynchospora rariflora*	E-P
Beakrush	*Rhynchospora perplexa*	T
Beakrush, white	*Rhynchospora alba*	E-P
Beakrush, Wright	*Rhynchospora wrightiana*	E-P
Beardgrass, broad-leaved	*Gymnopogon brevifolius*	S
Beauty, Gyandotte	*Synandra hispidula*	T
Bedstraw, rough	*Galium asprellum*	S
Beechfern, northern	*Thelypteris phegopteris*	S
Bellflower, marsh	*Campanula aparinoides*	S
Bindweed, fringed black	*Polygonum cilinode*	T
Bladderpod, Duck River	*Lesquerella densipila*	T
Bladderpod, Spring Creek	*Lesquerella perforata*	E
Bladderpod, Stones River	*Lesquerella stonensis*	E
Bladderwort, zigzag	*Utricularia subulata*	T
Blazing-star, slender	*Liatris cylindracea*	E
Blueberry, small black	*Vaccinium tenellum*	E-P
Bluegrass, fowl	*Poa palustris*	S
Bluegrass	*Poa saltuensis*	S
Bristle-fern	*Trichomanes boschianum*	T
Brome, fringed	*Bromus ciliatus*	S
Broomrape, Louisiana	*Orobanche ludoviciana*	S
Buckthorn, alderleaf	*Rhamnus alnifolia*	E
Bugbane, Appalachian	*Cimicifuga rubifolia*	T
Bugbane, green-and-gold	*Chrysogonum virginianum*	T
Bulbostylis	*Bulbostylis ciliatifolia* var. *coarctata*	S
Bulrush, water	*Scirpus subterminalis*	S
Bunchflower, hybrid	*Melanthium hybridum*	E

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Plants (continued):		
Bunchflower, Virginia	*Melanthium virginicum*	E
Burnet, Canada	*Sanguisorba canadensis*	E
Bur-reed, branching	*Sparganium androcladum*	E-P
Bush, fetter-	*Leucothoe racemosa*	T
Bush, pirate	*Buckleya distichophylla*	T
Bush-pea, ash-leaved	*Thermopsis fraxinifolia*	T
Bushclover, narrowleaf	*Lespedeza angustifolia*	T
Buttons, bog-	*Lachnocaulon anceps*	E
Cabbage, John's	*Hydrophyllum virginianum*	T
Cabbage, skunk	*Symplocarpus foetidus*	E
Camas, death	*Zigadenus leimanthoides*	T
Camas, white	*Zigadenus glaucus*	E
Catchfly, ovate	*Silene ovata*	T
Catchfly, royal	*Silene regia*	E-P
Catfoot	*Gnaphalium helleri*	S
Chaffseed	*Schwalbea americana*	E-P
Chainfern, Virginia	*Woodwardia virginica*	S
Cherry, choke	*Prunus virginiana*	S
Cherry, sand	*Prunus pumila*	E
Cinquefoil, three-toothed	*Potentilla tridentata*	S
Club-rush, tufted	*Scirpus cespitosus*	T
Clubmoss, fir	*Lycopodium selago*	T
Clubmoss, foxtail	*Lycopodium alopecuroides*	E-P
Clubmoss, stiff	*Lycopodium annotinum*	E-P
Cohosh, blue	*Caulophyllum giganteum*	T
Coneflower, pale-purple	*Echinacea pallida*	T
Coneflower, sweet	*Rudbeckia subtomentosa*	T
Coneflower, Tennessee	*Echinacea tennesseensis*	E
Coralroot, spotted	*Corallorhiza maculata*	T
Cotton-grass, tawny	*Eriophorum virginicum*	T
Cow-plantain	*Heracleum maximum*	S
Cranberry, large	*Vaccinium macrocarpon*	T
Cress, bitter	*Cardamine flagellifera*	T
Cress, mountain bitter	*Cardamine clematitis*	T
Cress, round-leaf water	*Cardamine rotundifolia*	T

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Plants (continued):		
Croton, Alabama	*Croton alabamensis*	E-P
Crowfoot, Allegheny Mountain	*Ranunculus allegheniensis*	S
Dandelion, false	*Krigia montana*	T
Dewberry, Wharton's	*Rubus whartoniae*	S
Dropseed	*Sporobolus junceus*	S
Dropseed, Torrey's	*Muhlenbergia torreyana*	E-P
Elm, cedar	*Ulmus crassifolia*	S
Eulophus, eastern	*Perideridia americana*	E
Evening-primrose, large-flowered	*Oenothera grandiflora*	S
Evening-primrose, Missouri	*Oenothera missouriensis*	E
Evolvulus	*Evolvulus pilosus*	S
False-asphodel, coastal	*Tofieldia racemosa*	T
False-foxglove, Shinner's	*Agalinis pseudaphylla*	E
False-foxglove, spreading	*Aureolaria patula*	E
False-gromwell, shaggy	*Onosmodium molle* var. *hispidissimum*	S
False-loosestrife, globe-fruited	*Ludwigia sphaerocarpa*	T
Fameflower, limestone	*Talinum calcaricum*	T
Fameflower, roundleaf	*Talinum teretifolium*	T
Featherfoil	*Hottonia inflata*	S
Fern, bog	*Thelypteris simulata*	E-P
Fern, Hart's-tongue	*Phyllitis scolopendrium* var. *americanum*	E
Fern, sweet	*Comptonia peregrina*	E
Fescue, cluster	*Festuca paradoxa*	S
Fetter-bush, mountain	*Pieris floribunda*	T
Filmy-fern, dwarf	*Trichomanes petersii*	E
Fimbry, Vahl hairy	*Fimbristylis puberula*	T
Fir, Fraser	*Abies fraseri*	T
Fireweed	*Epilobium angustifolium*	S
Flag, slender blue	*Iris prismatica*	T
Flame-flower, Menge's	*Talium mengesii*	T
Foxglove, earleaf	*Tomanthera auriculata*	E
Frostweed, Canada	*Helianthemum canadense*	S
Frostweed, low	*Helianthemum propinquum*	S
Frostweed, plains	*Helianthemum bicknellii*	E-P

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Plants (continued):		
Fumatory, climbing	*Adlumia fungosa*	T
Galingale	*Cyperus plukenetii*	S
Gentian, Appalachian	*Gentiana austromontana*	T
Gentian, narrow-leaved	*Gentiana linearis*	T
Gentian, rose	*Sabatia capitata*	E
Gerardice	*Agalinis gatesii*	E-P
Ginseng, American	*Panax quinquefolius*	T
Glade-cress, necklace	*Leavenworthia torulosa*	T
Glade-cress	*Leavenworthia exigua* var. *exigua*	T
Glade-cress	*Leavenworthia exigua* var. *lutea*	E-P
Glade-cress	*Leavenworthia stylosa*	S
Goat's-beard, crenate-lobed false	*Astilbe crenatiloba*	E-P
Goldenrod, Blue Ridge	*Solidago spithamaea*	S
Goldenrod, broad-leaf	*Solidago lancifolia*	E
Goldenrod, Gattinger	*Solidago gattingeri*	E-P
Goldenrod, prairie	*Solidago ptarmicoides*	E-P
Goldenrod, rock	*Solidago rupestris*	E
Goldenrod	*Solidago tarda*	S-P
Grape, sand	*Vitis rupestris*	S-P
Grape-fern, Alabama	*Botrychium alabamense*	
Grape-fern, matricary	*Botrychium matricariifolium*	S
Grass, bent	*Agrostis borealis* var. *americana*	S
Grass, branching Whitlow	*Draba ramosissima*	S
Grass, fringed yellow-eyed	*Xyris fimbriata*	E
Grass, panic	*Panicum curtifolium*	S
Grass, panic	*Panicum ensifolium*	S
Grass, Tennessee yellow-eyed	*Xyris tennesseensis*	E
Grass, yellow-eyed	*Xyris iridifolia*	S
Grass-of-parnassus, large-flowered	*Parnassia grandifolia*	S
Greenbrier, laurel-leaf	*Smilax laurifolia*	E
Gromwell, false	*Onosmodium molle* ssp. *molle*	S
Gromwell, false	*Onosmodium molle* ssp. *occidentale*	T
Hawkweed, rough	*Hieracium scabrum*	T
Hawthorn	*Crataegus harbisonii*	E-P

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Plants (continued):		
Heartleaf, southern	*Hexastylis contracta*	T
Heartleaf, Virginia	*Hexastylis virginica*	S
Hedge-hyssop, Florida	*Gratiola floridana*	E-P
Hedge-nettle, Clingman	*Stachys clingmanii*	T
Hellebore, Wood's false	*Veratrum woodii*	E
Hemlock, Carolina	*Tsuga caroliniana*	S
Honeysuckle, American fly	*Lonicera canadensis*	S
Honeysuckle, grape	*Lonicera prolifera*	E-P
Honeysuckle, mountain	*Lonicera dioica*	S
Honeysuckle, mountain bush-	*Diervilla sessilifolia* var. *rivularis*	T
Honeysuckle, northern bush-	*Diervilla lonicera*	T
Honeysuckle, yellow	*Lonicera flava*	S
Horse-sugar	*Symplocos tinctoria*	S
Huckleberry, dwarf	*Gaylussacia dumosa*	T
Hyssop, purple giant	*Agastache scrophulariifolia*	S
Indiana-plantain, sweet-scented	*Cacalia suaveolens*	T
Iris, Lamance	*Iris brevicaulis*	E
Iris, red	*Iris fulva*	S
Jessamine, yellow	*Gelsemium sempervirens*	S
Jointweed, southern	*Polygonella americana*	E
Ladies'-tresses, lesser	*Spiranthes ovalis*	S
Ladies'-tresses, shining	*Spiranthes lucida*	T
Ladies'-tresses, sweetscent	*Spiranthes odorata*	E
Ladies'-tresses, yellow nodding	*Spiranthes ochroleuca*	E-P
Lady-slipper, showy	*Cypripedium reginae*	E
Lady-slipper, southern	*Cypripedium kentukiense*	E
Larkspur, tall	*Delphinium exaltatum*	E
Laurel, sheep-	*Kalmia angustifolia* var. *carolina*	E-P
Leafcup, Tennessee	*Polygonum laevigata*	S
Lily, Canada	*Lilium canadense*	T
Lily, Clinton	*Clintonia borealis*	S
Lily, Gray's	*Lilium grayi*	E
Lily, Michigan	*Lilium michiganense*	T
Lily, wood	*Lilium philadelphicum*	E

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Plants (continued):		
Lobelia, Canby	*Lobelia canbyi*	T
Lobelia, Gattinger's	*Lobelia appendiculata* var. *gattingeri*	T
Lobelia, southern	*Lobelia amoena*	S
Loosestrife, Fraser	*Lysimachia fraseri*	E
Loosestrife, swamp	*Lysimachia terrestris*	S
Lousewort, swamp	*Pedicularis lanceolata*	T
Magnolia, sweetbay	*Magnolia virginiana*	T
Maidencane	*Panicum hemitomon*	S
Mallow, Virginia	*Sida hermaphrodita*	E-P
Mandarin, white	*Streptopus amplexifolius*	T
Manna-grass, American	*Glyceria grandis*	E-P
Manna-grass, pale	*Glyceria pallida*	S
Manna-grass, rattlesnake	*Glyceria laxa*	S
Manna-grass, sharp-scaled	*Glyceria acutiflora*	S
Manna-grass, Smoky Mountains	*Glyceria nubigena*	E
Maple, chalk	*Acer saccharum* ssp. *leucoderme*	S
Marigold, marsh	*Caltha palustris*	E
Mary, spring blue-eyed	*Collinsia verna*	E
Meadow-sweet, narrow-leaved	*Spiraea alba*	E
Meadowrue, leatherleaf	*Thalictrum coriaceum*	T
Meehania, heartleaf	*Meehania cordata*	T
Milk-vetch, Tennessee	*Astragalus tennesseensis*	E
Milkweed, green	*Asclepias hirtella*	S
Milkweed, purple	*Asclepias purpurascens*	S
Milkwort, Boykin	*Polygala boykinii*	S
Milkwort, dwarf	*Polygala nana*	S
Milkwort, Maryland	*Polygala mariana*	S
Milkwort, Nuttall	*Polygala nuttallii*	E-P
Millet-grass, tall	*Milium effusum*	S
Minniebush	*Menziesia pilosa*	S
Mountain-lover, Canby's	*Pachistima canbyi*	S
Mountain-mint	*Pycnanthemum curvipes*	S
Mountain-mint, whorled	*Pycnanthemum verticillatum*	E-P
Mud-plantain, blue	*Heteranthera limosa*	E

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Plants (continued):		
Muhlenbergia, plains	*Muhlenbergia cuspidata*	E
Muhly	*Muhlenbergia glabriflora*	S
Mustard, Lesquereux's	*Lesquerella globosa*	T
Mustard, tower	*Arabis glabra*	S
Nestronia	*Nestronia umbellula*	E
Nutrush, low	*Scleria verticillata*	S
Nutrush, slender	*Scleria minor*	E
Oak, Nuttall	*Quercus nuttallii*	S
Onion, glade	*Allium stellatum*	E
Orchid, fen	*Liparis loeselii*	E-P
Orchid, large purple-fringe	*Platanthera grandiflora*	S
Orchid, large roundleaf	*Platanthera orbiculata*	E
Orchid, long-bract green	*Coeloglossum viride* var. *virescens*	T
Orchid, pale green	*Platanthera flava* var. *herbiola*	T
Orchid, purple fringeless	*Platanthera peramoena*	T
Orchid, small purple-fringe	*Platanthera psycodes*	T
Orchid, snowy	*Platanthera nivea*	E
Orchid, southern rein	*Platanthera flava* var. *flava*	S
Orchid, white fringeless	*Platanthera integrilabia*	E
Orchid, yellow fringeless	*Platanthera integra*	E
Paper birch, heart-leaved	*Betula papyrifera* var. *cordifolia*	E
Parsley, prairie	*Polytaenia nuttallii*	T
Phlox, cleft	*Phlox bifida* ssp. *stellaria*	T
Phlox, downy	*Phlox pilosa* ssp. *ozarkana*	S
Pinesap, sweet	*Monotropsis odorata*	T
Pink, cardina	*Silene caroliniana* ssp. *pensylvanica*	T
Pitcher-plant, green	*Sarracenia oreophila*	E-P
Plant, compass	*Silphium laciniatum*	T
Plum, ground	*Astragalus crassicarpus* var. *crassicarpus*	E
Pogonia, rose	*Pogonia ophioglossoides*	T
Pogonia, small whorled	*Isotria medeoloides*	S
Pondweed, large-leaf	*Potamogeton amplifolius*	T
Pondweed, Nuttall	*Potamogeton epihydrus*	S
Pondweed, Tennessee	*Potamogeton tennesseensis*	T

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Plants (continued):		
Potato-bean, Price's	*Apios priceana*	E
Prairie-clover, leafy	*Dalea foliosa*	E
Prairie-clover, purple	*Dalea purpurea*	E
Prairie-clover, white	*Dalea candida*	E
Prairie-dock	*Silphium pinnatifidum*	E
Purslane, water-	*Didiplis diandra*	T
Quillwort, blackfoot	*Isoetes melanopoda*	E
Quillwort, lake	*Isoetes macrospora*	E
Ragwort, Rugel's	*Cacalia rugelia*	T
Rattlebox	*Crotalaria purshii*	E-P
Rattlesnake-root, mountain	*Prenanthes roanensis*	T
Rattlesnake-root, nodding	*Prenanthes crepidinea*	E
Rattlesnake-root, rough	*Prenanthes aspera*	E
Redroot, Carolina	*Lachnanthes caroliana*	E
Reedgrass, Cain's	*Calamagrostis cainii*	E
Reedgrass, Porter's	*Calamagrostis porteri*	E
Rhynchosia, Prairie	*Rhynchosia latifolia*	E-P
Rockcress, large	*Arabis perstellata* var. *ampla*	E
Rockcress, hairy	*Arabis hirsuta*	S
Rockcress, spreading	*Arabis patens*	E-P
Rosemary, Cumberland	*Conradina verticillata*	T
Rosinweed	*Silphium brachiatum*	E
Rush, naked-fruited	*Juncus gymnocarpus*	T
Rush, one-flowered	*Juncus trifidus* ssp. *carolinianus*	E-P
Rush, small-head	*Juncus brachycephalus*	S
Rush, twig	*Cladium mariscoides*	E-P
Sage, blue	*Salvia azurea* var. *grandiflora*	S
Sage, lance-leaved	*Salvia reflexa*	T
Sand-parsley, Pope	*Ammoselinum popei*	T
Sandgrass	*Calamovilfa arcuata*	E
Sandwort, Cumberland	*Arenaria cumberlandensis*	E
Sandwort, mountain	*Arenaria groenlandica*	E
Sandwort	*Arenaria lanuginosa*	E-P

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Plants (continued):		
Savory	*Satureja glabella*	S
Saxifrage, Carey	*Saxifraga careyana*	S
Saxifrage, Carolina	*Saxifraga caroliniana*	E
Scarf-pea, southern	*Psoralea subacaulis*	S
Scorpion-weed, blue	*Phacelia ranunculacea*	T
Seal, golden	*Hydrastis canadensis*	T
Sedge, Barratt's	*Carex barrattii*	E-P
Sedge, beaked	*Carex rostrata*	T
Sedge, bristly	*Carex comosa*	S
Sedge, brown bog	*Carex buxbaumii*	S
Sedge, Crawe	*Carex crawei*	S
Sedge, Davis	*Carex davisii*	S
Sedge, Fraser's	*Cymophyllus fraseri*	T
Sedge, giant-white-top-	*Dichromena latifolia*	E-P
Sedge, heavy	*Carex gravida*	S
Sedge, Hitchcock	*Carex hitchcockiana*	T
Sedge, Howe	*Carex howei*	E-P
Sedge, lake-bank	*Carex lacustris*	T
Sedge, longstalk	*Carex pedunculata*	S
Sedge, Muskingum	*Carex muskingumensis*	E-P
Sedge, porcupine	*Carex hystericina*	S
Sedge, pubescent	*Carex hirtifolia*	S
Sedge, reniform	*Carex reniformis*	S
Sedge, Roan Mountain	*Carex roanensis*	E
Sedge, Ruth	*Carex ruthii*	T
Sedge	*Carex vestita*	E-P
Sedge	*Carex angustior*	S-P
Sedge	*Carex oxylepis* var. *pubescens*	S
Sedge, three-seed	*Carex trisperma*	S
Sedge, toothed	*Cyperús dentatus*	S
Sedge, woolly	*Carex lanuginosa*	E-P
Sedge, wretched	*Carex misera*	T
Serviceberry, running	*Amelanchier spicata*	S
Seymeria	*Seymeria cassioides*	E-P

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Plants (continued):		
Shadbush, roundleaf	*Amelanchier sanguinea*	T
Shadow-witch	*Ponthieva racemosa*	E
Shield-fern, crested	*Dryopteris cristata*	S
Shield-fern	*Dryopteris carthusiana*	T
Silverling	*Paronychia argyrocoma*	T
Skullcap, large-flowered	*Scutellaria montana*	E
Skullcap, rock	*Scutellaria saxatilis*	T
Smoke-tree, American	*Cotinus obovatus*	S
Snakeroot, black	*Zigadenus densus*	E-P
Sneezeweed, shortleaf	*Helenium brevifolium*	E
Snow-wreath, Alabama	*Neviusia alabamensis*	T
Soloman's seal, starflower false	*Smilacina stellata*	S
Speedwell, marsh-	*Veronica scutellata*	E-P
Speedwell, water	*Veronica comosa*	E-P
Spikerush, horse-tail	*Eleocharis equisetoides*	S
Spikerush, matted	*Eleocharis intermedia*	S
Spikerush, twisted	*Eleocharis tortilis*	S
Spilanthes	*Spilanthes americana* var. *repens*	E
Spirea, Virginia	*Spiraea virginiana*	E
Spirea, corymbed	*Spiraea corymbosa*	E
Squarehead, pineland	*Tetragonotheca helianthoides*	E
Squaw-weed, Robbins	*Senecio schweinitzianus*	T
St. John's-wort, Blue Ridge	*Hypericum mitchellianum*	T
St. John's-wort, mountain (creeping)	*Hypericum adpressum*	T
St. John's-wort, mountain	*Hypericum graveolens*	T
St. John's-wort, pale	*Hypericum ellipticum*	E
Star, blue	*Amsonia tabernaemontana* var. *gattingeri*	S
Starflower, northern	*Trientalis borealis*	T
Stitchwort, Godfrey's	*Arenaria godfreyi*	E-P
Stitchwort, longleaf	*Stellaria longifolia*	E-P
Stitchwort, trailing	*Stellaria alsine*	S
Stitchwort, water	*Arenaria fontinalis*	E
Stonecrop, Nevius'	*Sedum nevii*	E
Stonecrop, small	*Diamorpha cymosa*	E
Strawberry-bush, running	*Euonymus obovatus*	S

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Plants (continued):		
Sundew, dwarf	*Drosera brevifolia*	T
Sundew, pink	*Drosera capillaris*	T
Sunflower, Eggert's	*Helianthus eggertii*	S
Sunflower, white-leaved	*Helianthus glaucophyllus*	E
Sunnybell, yellow	*Schoenolirion croceum*	T
Tearthumb, halberdleaf	*Polygonum arifolium*	T
Thistle, yellow	*Carduus spinosissimus*	S
Thoroughwort, Braun's	*Eupatorium luciae-brauniae*	T
Thoroughwort, white-bract	*Eupatorium leucolepis*	E
Tickseed, broad-leaved	*Coreopsis latifolia*	E
Trillium, least	*Trillium pusillum* var. *pusillum*	E
Trillium, narrow-leaved	*Trillium lancifolium*	E
Trillium, nodding	*Trillium rugelii*	E
Trillium, Ozark least	*Trillium pusillum* var. *ozarkanum*	E
Trillium, trailing	*Trillium decumbens*	E
Trout-lily, yellow	*Erythronium rostratum*	S
Turkeybeard, eastern	*Xerophyllum asphodeloides*	T
Twayblade, kidney-leaf	*Listera smallii*	T
Twayblade, southern	*Listera australis*	E
Twinflower	*Linnaea borealis*	E-P
Twisted-stalk, rosy	*Streptopus roseus*	S
Umbrella-plant, Harper's	*Eriogonum longifolium* var. *harperi*	E
Umbrella-sedge, Engelmann	*Cyperus engelmannii*	S
Umbrella-sedge, hairy	*Fuirena squarrosa*	S
Umbrella-wort, narrow-leaved	*Mirabilis linearis*	T
Umbrella-wort, pale	*Mirabilis albida*	T
(unnamed)	*Cerastium arvense* var. *oblongifolium*	E
(unnamed)	*Ceratophyllum echinatum*	S
(unnamed)	*Onosmodium subsetosum*	E
Violet, three parted	*Viola tripartita* var. *tripartita*	S
Wallflower, western	*Erysimum capitatum*	E
Water-crowfoot, white	*Ranunculus longirostris*	E
Water-crowfoot, yellow	*Ranunculus flabellaris*	T
Water-milfoil, cutleaf	*Myriophyllum pinnatum*	T

Table G-14. State-Designated Endangered and Threatened Species—Tennessee (continued)

Common name	Scientific name	Status
Plants (continued):		
Water-pennywort, American	*Hydrocotyle americana*	E
Waterweed, Nashville	*Elodea linearis*	E-P
Waterweed, Nuttall	*Elodea nuttallii*	S
Weed, pin	*Lechea leggettii*	S
Wild-rye, Svenson's	*Elymus svensonii*	E
Willow-herb, hairy	*Epilobium ciliatum*	S
Willow-herb, linear-leaved	*Epilobium leptophyllum*	T
Wintergreen, American	*Pyrola rotundifolia* var. *americana*	E
Witch-alder, mountain	*Fothergilla major*	T
Witchgrass, needle-leaf	*Panicum aciculare*	E
Witchgrass, roughish	*Panicum leucothrix*	S
Woodbine, scarlet	*Schisandra coccinea*	T
Woodsia, Rocky Mountain	*Woodsia scopulina*	S
Yew, American	*Taxus canadensis*	E

Table G-15. State-Designated Endangered and Threatened Species—Texas

Common name	Scientific name	Status
Mammals:		
Bat, Rafinesque's big-eared	*Plecotus rafinesquii*	T
Bat, southern yellow	*Lasiurus ega*	T
Bat, spotted	*Euderma maculatum*	T
Bear, black	*Ursus americanus*	E
Coati	*Nasua nasua*	E
Dolphin, Atlantic spotted	*Stenella plagiodon*	T
Dolphin, rough-toothed	*Steno bredanensis*	T
Ferret, black-footed	*Mustela nigripes*	E
Jaguar	*Felis onca*	E
Jaguarundi	*Felis yagouaroundi*	E
Manatee, West Indian	*Trichechus manatus*	E
Margay	*Felis wiedii*	E
Mouse, Palo Duro	*Peromyscus comanche*	T
Ocelot	*Felis pardalis*	E
Rat, Coues' rice	*Oryzomys couesi*	T
Rat, Texas kangaroo	*Dipodomys elator*	T
Whale, blue	*Balaenoptera musculus*	E
Whale, dwarf sperm	*Kogia simus*	T
Whale, false killer	*Pseudorca crassidens*	T
Whale, finback	*Balaenoptera physalus*	E
Whale, Gervais' beaked	*Mesoplodon europaeus*	T
Whale, goose-beaked	*Ziphius cavirostris*	T
Whale, killer	*Orcinus orca*	T
Whale, pygmy killer	*Feresa attenuata*	T
Whale, pygmy sperm	*Kogia breviceps*	T
Whale, right	*Balaena glacialis*	E
Whale, short-finned pilot	*Globicephala macrorhynchus*	T
Whale, sperm	*Physeter macrocephalus*	E
Wolf, gray	*Canis lupus*	E
Wolf, red	*Canis rufus*	E
Birds:		
Becard, rose-throated	*Pachyramphus aglaiae*	T
Crane, whooping	*Grus americana*	E
Curlew, Eskimo	*Numenius borealis*	E

Table G-15. State-Designated Endangered and Threatened Species—Texas

Common name	Scientific name	Status
Birds (continued):		
Eagle, bald	*Haliaeetus leucocephalus*	E
Egret, reddish	*Egretta rufescens*	T
Falcon, American peregrine	*Falco peregrinus anatum*	E
Falcon, aplomado	*Falco femoralis*	E
Falcon, Arctic peregrine	*Falco peregrinus tundrius*	E
Hawk, common black	*Buteogallus anthracinus*	T
Hawk, gray	*Buteo nitidus*	T
Hawk, white-tailed	*Buteo albicaudatus*	T
Hawk, zone-tailed	*Buteo albonotatus*	T
Ibis, white-faced	*Plegadis chihi*	T
Kite, American swallow-tailed	*Elanoides forficatus*	T
Owl, ferruginous pygmy	*Glaucidium brasilianum*	T
Parula, tropical	*Parula pitiayumi*	T
Pelican, brown	*Pelecanus occidentalis*	E
Plover, piping	*Charadrius melodus*	T
Prairie-chicken, Attwater's greater	*Tympanuchus cupido attwateri*	E
Sparrow, Bachman's	*Aimophila aestivalis*	T
Sparrow, Botteri's	*Aimophila botterii*	T
Stork, wood	*Mycteria americana*	T
Tern, interior least	*Sterna antillarum athalassos*	E
Tern, sooty	*Sterna fuscata*	T
Tyrannulet, northern beardless	*Camptostoma imberbe*	T
Vireo, black-capped	*Vireo atricapillus*	E
Warbler, golden-cheeked	*Dendroica chrysoparia*	T
Woodpecker, ivory-billed	*Campephilus principalis*	E
Woodpecker, red-cockaded	*Picoides borealis*	E
Reptiles:		
Lizards—		
Gecko, reticulated	*Coleonyx reticulatus*	T
Lizard, mountain short-horned	*Phrynosoma douglassii hernandesi*	T
Lizard, reticulate collared	*Crotaphytus reticulatus*	T
Lizard, Texas horned	*Phrynosoma cornutum*	T

Table G-15. State-Designated Endangered and Threatened Species—Texas

Common name	Scientific name	Status
Reptiles (continued):		
Snakes—		
Racer, speckled	*Drymobius m. margaritiferus*	E
Rattlesnake, timber	*Crotalus horridus*	T
Snake, Big Bend blackhead	*Tantilla rubra*	T
Snake, black-striped	*Coniophanes i. imperialis*	T
Snake, Brazos water	*Nerodia h. harteri*	T
Snake, Concho water	*Nerodia harteri paucimaculata*	E
Snake, Louisiana pine	*Pituophis melanoleucus ruthveni*	E
Snake, northern cat-eyed	*Leptodeira s. septentrionalis*	E
Snake, northern scarlet	*Cemophora coccinea copei*	T
Snake, Texas indigo	*Drymarchon corais erebennus*	T
Snake, Texas iyre	*Trimorphodon biscutatus vilkinsonii*	T
Snake, Texas scarlet	*Cemophora coccinea lineri*	T
Snake, western smooth green	*Opheodrys vernalis blanchardi*	E
Turtles—		
Hawksbill, Atlantic	*Eretmochelys i. imbricata*	E
Leatherback	*Dermochelys coriacea*	E
Loggerhead	*Caretta caretta*	E
Ridley, Atlantic	*Lepidochelys kempii*	E
Tortoise, Texas	*Gopherus berlandieri*	T
Turtle, alligator snapping	*Macroclemys temminckii*	T
Turtle, Atlantic green	*Chelonia m. mydas*	T
Turtle, Big Bend mud	*Kinosternon hirtipes murrayi*	E
Amphibians:		
Salamanders—		
Newt, black-spotted	*Notophthalmus meridionalis*	E
Salamander, Blanco blind	*Typhlomolge robusta*	E
Salamander, Cascade Caverns	*Eurycea latitans*	T
Salamander, Comal blind	*Eurycea tridentifera*	T
Salamander, San Marcos	*Eurycea nana*	T
Salamander, Texas blind	*Typhlomolge rathbuni*	E
Siren, Rio Grande lesser	*Siren intermedia texana*	E

Table G-15. State-Designated Endangered and Threatened Species—Texas

Common name	Scientific name	Status
Amphibians (continued):		
Frogs and toads—		
Frog, sheep	*Hypopachus variolosus*	T
Frog, white-lipped	*Leptodactylus fragilis*	E
Toad, Houston	*Bufo houstonensis*	E
Toad, Mexican burrowing	*Rhinophrynus dorsalis*	T
Treefrog, Mexican	*Smilisca baudinii*	T
Fish:		
Blindcat, toothless	*Trogloglanis pattersoni*	T
Blindcat, widemouth	*Satan eurystomus*	T
Chub, Rio Grande	*Gila pandora*	T
Chubsucker, creek	*Erimyzon oblongus*	T
Darter, blackside	*Percina maculata*	T
Darter, fountain	*Etheostoma fonticola*	E
Darter, Rio Grande	*Etheostoma grahami*	T
Gambusia, Amistad	*Gambusia amistadensis*	E
Gambusia, Big Bend	*Gambusia gaigei*	E
Gambusia, Clear Creek	*Gambusia heterochir*	E
Gambusia, blotched	*Gambusia senilis*	E
Gambusia, Pecos	*Gambusia nobilis*	E
Gambusia, San Marcos	*Gambusia georgei*	E
Goby, blackfin	*Gobionellus atripinnis*	E
Goby, river	*Awaous tajasica*	T
Minnow, Devil's River	*Dionda diaboli*	T
Paddlefish	*Polyodon spathula*	E
Pipefish, opposum	*Oostethus brachyurus*	T
Pupfish, Comanche Springs	*Cyprinodon elegans*	E
Pupfish, conchos	*Cyprinodon eximius*	T
Pupfish, Leon Springs	*Cyprinodon bovinus*	E
Pupfish, Pecos	*Cyprinodon pecosensis*	T
Shiner, bluehead	*Notropis hubbsi*	T
Shiner, bluntnose	*Notropis simus*	E
Shiner, Chihuahua	*Notropis chihuahua*	T
Shiner, phantom	*Notropis orca*	E

Table G-15. State-Designated Endangered and Threatened Species—Texas

Common name	Scientific name	Status
Fish (continued):		
Shiner, proserpine	*Notropis proserpinus*	T
Stoneroller, Mexican	*Campostoma ornatum*	T
Sturgeon, shovelnose	*Scaphirhynchus platorynchus*	E
Sucker, blue	*Cycleptus elongatus*	T
Plants:		
Bitterweed, Texas	*Hymenoxys texana*	E
Bladderpod, white	*Lesquerella pallida*	E
Cactus, black lace	*Echinocereus reichenbachii* var. *albertii*	E
Cactus, bunched cory	*Coryphantha ramillosa*	T
Cactus, Lloyd's hedgehog	*Echinocereus lloydii*	E
Cactus, Lloyd's Mariposa	*Neolloydia mariposensis*	T
Cactus, Nellie cory	*Coryphantha minima*	E
Cactus, Sneed pincushion	*Coryphantha sneedii* var. *sneedi*	E
Cactus, Tobusch fishhook	*Ancistrocactus tobuschii*	E
Dogweed, ashy	*Thymophylla tephroleuca*	E
Frankenia, Johnston's	*Frankenia johnstonii*	E
Ladies'-tresses, Navasota	*Spiranthes parksii*	E
Pennyroyal, McKittrick	*Hedeoma apiculatum*	T
Pitaya, Davis' green	*Echinocereus viridiflorus* var. *davisii*	E
Poppy-mallow, Texas	*Callirhoe scabriuscula*	E
Rush-pea, slender	*Hoffmannseggia tenella*	E
Snowbells, Texas	*Styrax texana*	E
Wild-rice, Texas	*Zizania texana*	E

Table G-16. State-Designated Endangered and Threatened Species—Virginia

Common name	Scientific name	Status
Mammals:		
Bat, gray	*Myotis grisescens*	E
Bat, Indiana	*Myotis sodalis*	E
Bat, Rafinesque's big-eared	*Plecotus rafinesquii*	E
Bat, Virginia big-eared	*Plecotus townsendii virginianus*	E
Fisher	*Martes pennanti*	E
Shrew, water	*Sorex palustris*	E
Squirrel, Delmarva Peninsula fox	*Sciurus niger cinereus*	E
Squirrel, northern flying	*Glaucomys sabrinus coloratus*	E
Birds:		
Eagle, bald	*Haliaeetus leucocephalus*	E
Falcon, American peregrine	*Falco peregrinus*	E
Plover, Wilson's	*Charadrius wilsonia*	E
Shrike, loggerhead	*Lanius ludovicianus*	E
Woodpecker, red-cockaded	*Picoides (=Dendrocopus) borealis*	E
Wren, Bewick's	*Thryomanes bewickii*	E
Reptiles:		
Turtles—		
Turtle, bog	*Clemmys muhlenbergii*	E
Turtle, chicken	*Deirochelys reticularia*	E
Turtle, green sea	*Chelonia mydas*	E
Turtle, Hawksbill sea	*Eretmochelys imbricata*	E
Turtle, Kemp's ridley sea	*Lepidochelys kempii*	E
Turtle, leatherback sea	*Dermochelys coriacea*	E
Turtle, loggerhead sea	*Caretta caretta*	E
Amphibians:		
Salamanders—		
Salamander, eastern tiger	*Ambystoma tigrinum*	E
Salamander, Shenandoah	*Plethodon shenandoah*	E
Fish:		
Chub, slender	*Hybopsis cahni*	E
Chub, spotfin	*Hybopsis monacha*	E
Darter, blueside	*Etheostoma jessiae*	E

Table G-16. State-Designated Endangered and Threatened Species—Virginia (continued)

Common name	Scientific name	Status
Fish (continued):		
Darter, Carolina	*Etheostoma collis*	E
Darter, sharphead	*Etheostoma acuticeps*	E
Darter, Tippecanoe	*Etheostoma tippecanoe*	E
Madtom, yellowfin	*Noturus flavipinnis*	E
Sturgeon, shortnose	*Acipenser brevirostrum*	E
Sunfish, blackbanded	*Enneacanthus chaetodon*	E
Mollusks:		
Combshell, Cumberland	*Epioblasma brevidens*	E
Pearly mussel, Appalachian monkeyface	*Quadrula sparsa*	E
Pearly mussel, birdwing	*Conradilla caelata*	E
Pearly mussel, Cumberland monkeyface	*Quadrula intermedia*	E
Pearly mussel, dromedary	*Dromus dromas*	E
Pearly mussel, fine-rayed pigtoe	*Fusconaia cunelolus*	E
Pearly mussel, green blossom	*Epioblasma torulosa gubernaculum*	E
Pearly mussel, little-wing	*Pegias fabula*	E
Pearly mussel, oyster	*Epioblasma capsaeformis*	E
Pearly mussel, snuffbox	*Epioblasma triquetra*	E
Pigtoe, rough	*Pleurobema plenum*	E
Pigtoe, shiny	*Fusconaia edgariana*	E
Riffle shell, tan	*Epioblasma walkeri*	E
Snail, Virginia fringed mountain	*Polygriscus virginianus*	E
Spinymussel, James River	*Pleurobema collina*	E
Arthropods:		
Isopod, Madison Cave	*Antrolana lira*	E
Plants:		
Birch, Virginia	*Betula uber*	E
Ginseng, American	*Panax quintuefolius*	T
Pogonia, large whorled	*Isotria medeoloides*	E

Appendix H

Analysis and Protection of Endangered and Threatened Species

This appendix describes the steps the Animal and Plant Health Inspection Service (APHIS) has taken to assess the possible effects of the National Boll Weevil Cooperative Control Program on federally listed endangered, threatened, and proposed species in the cotton-producing counties in the 17 Cotton Belt States. This appendix was originally part of the two-part supplement to the draft EIS published on July 29, 1991.

Section 1 describes the purpose of this analysis and contains an overview of the organization of this appendix. Section 2 summarizes the Endangered Species Act of 1973 (ESA), as amended, as it pertains to this program. Section 3 describes the methodologies used to assess the potential risks to the 198 federally listed endangered, threatened, or proposed species found in the program area. Section 4 provides descriptions and analyses of 16 example species. Attachment A is a list of all the federally listed species analyzed in the biological assessment and their regulatory status, and attachment B provides location maps for all 198 species.

Section 1

Purpose and Need

Introduction

The U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), has proposed a National Boll Weevil Cooperative Control Program to be implemented in 17 southern States across the U.S. Cotton Belt. In 1989 APHIS prepared and published a draft environmental impact statement (DEIS) describing the potential impacts of the program on the human environment. The preferred alternative of the APHIS program is eradication (with full Federal involvement) of the boll weevil in the United States.

In 1990 APHIS prepared a biological assessment in accordance with the Endangered Species Act (ESA) of 1973, as amended. The biological assessment is intended to initiate formal consultation between APHIS and the U.S. Fish and Wildlife Service (FWS) of the U.S. Department of the Interior to assess the impact that the proposed control program may have on the 198 federally listed endangered, threatened, and proposed species in the affected States. The two agencies will work together to determine which protection measures will ensure that those species are not jeopardized by the program and that their critical habitats are not destroyed or adversely modified.

APHIS will conduct site-specific environmental assessments, as necessary, as the program is implemented over the next 20 years throughout the Cotton Belt. In those environmental assessments, APHIS will use the biological assessment and the related FWS biological opinion to plan and implement specific safeguards to protect endangered, threatened, and proposed species on a county-by-county basis.

Organization of This Appendix

Section 2 of this appendix provides an overview of the ESA and discusses its relationship to the National Environmental Policy Act. The section also discusses the biological assessment's relationship to the EIS and explains the consultation process between APHIS and the FWS.

Section 3 explains the methodologies used to assess the control program's potential effect on each endangered, threatened, or proposed wildlife species. A decision-tree analysis and a quantitative risk assessment of the program's chemical insecticides were the principal methodologies used. The three parts of the risk assessment—hazard analysis, exposure analysis, and risk analysis—are described, with special emphasis on the regulatory criteria used to determine risk to endangered and threatened species.

Section 4 contains descriptions of 16 example species from different taxa of endangered, threatened, or proposed species in the National Boll Weevil Cooperative Control Program area. The species' descriptions summarize each organism's physical characteristics, habitat requirements, and the reasons for its decline to endangered or

threatened status. In addition, the species' descriptions contain the results of the endangered and threatened species risk assessment, including an analysis of the program's potential impact on each species, and indicate APHIS' "may affect/no effect" conclusion based on the analysis. The section also provides a summary table of the "may affect/no effect" risk designations for all 198 species by taxa.

The conclusion, section 5, stresses APHIS' ongoing evaluation of potential risk to endangered and threatened species through the completion of site-specific environmental assessments. As the control program moves into each region of the Cotton Belt, the site-specific assessments will reevaluate the potential risks to the endangered, threatened, or proposed species already included in the biological assessment and will analyze the risks to any additional species that have been listed or proposed since completion of the biological assessment.

Attachment A lists the 198 endangered, threatened, and proposed species evaluated in the biological assessment and gives their regulatory status.

Attachment B lists the general habitat locations of the 198 endangered, threatened, and proposed species evaluated in this document. The 17 Cotton Belt States have been divided into four regions: Southeast-Coastal; Southeast-Delta; South Central, and Southwest. Numbers on the map indicate the general location of these species in these regions.

Section 2

The Endangered Species Act

The Endangered Species Act of 1973 (ESA), as amended, is intended to conserve fish, wildlife, and plants in the United States. The law prohibits the Federal Government from funding, authorizing, or carrying out any action that is likely to jeopardize any species, or adversely modify its critical habitat, that the U.S. Fish and Wildlife Service (FWS) lists as endangered or threatened or designates as critical habitat, respectively. In addition, private citizens are prohibited from taking, that is, harming, harassing, capturing, or killing any listed species.

A species may be given protection under ESA when sufficient scientific and commercial data exist to indicate that the species is in danger of extinction or is likely to become so in the foreseeable future. After a species is officially listed as endangered or threatened, the Federal Government (the FWS and the National Marine Fisheries Service) is required to make every effort to protect and ultimately improve the status of the species.

Any species that is in danger of extinction throughout all or a significant portion of its range may be listed as an endangered species. Any species that is likely to become endangered in the foreseeable future may be listed as a threatened species. Also, some species may be listed under the similarity of appearance clause. This clause mandates the protection of any nonendangered species that resembles a listed species so closely that the enforcement staff would have difficulty differentiating the two species. To initiate the listing process, the FWS publishes an animal and plant Notice of Review, which identifies those species being considered (candidate species) as possible additions to the endangered and threatened species list. This list is divided into three categories: Category 1—taxa for which there is substantial information available to support proposing a species for listing as endangered or threatened; Category 2—taxa for which conclusive data are not currently available; and Category 3—taxa that were once considered for listing but are not currently receiving such consideration.

When a species is proposed for listing, a notice is published in the Federal Register requesting data and public comments. The comment period lasts 45 days, and all comments and information received are considered before the final determination of endangered or threatened status.

The listing of a species does not require an environmental impact statement (EIS), as described in Section 4(a), and confirmed in *Pacific Legal Foundation* v. *Andrus*, 657 F 2d. 829 (6th Circuit 1981) (55 FR 26114, June 26, 1990). Instead, the listing of a species must be based solely on scientific and commercial data that indicate that the species' continued existence is jeopardized. The legislative history clearly states that the

intent of the ESA is to "prevent non-biological considerations from affecting such decisions" (55 FR 26114, June 26, 1990). Nonbiological considerations include economic impacts.

Each Federal agency is required to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any species listed as endangered or threatened, or result in the destruction or adverse modification of critical habitat. To fulfill this responsibility, an agency may request information from the Secretary of the Interior about whether any listed or proposed species may be present in the area of the proposed action. If, based on the best scientific and commercial data available, listed or proposed species may be present in the action area, the agency shall prepare a biological assessment to identify any such species likely to be affected by the action. The biological assessment may be included in an EIS as part of the agency's compliance with the National Environmental Policy Act.

After the biological assessment is completed, it is submitted to the FWS for review and concurrence. However, if it is determined that the action may affect threatened or endangered species or their critical habitats, the agency may request formal consultation concurrent with submission of the biological assessment. The FWS then reviews the document and prepares their evaluation in the form of a Biological Opinion. In the Biological Opinion, the FWS determines which species, if any, are likely to be jeopardized by the proposed action and which critical habitats, if any, are likely to be destroyed or adversely modified. If jeopardy or adverse modification is determined, the FWS will suggest "reasonable and prudent alternatives," if any, to avoid this impact and allow the project to proceed.

The National Boll Weevil Cooperative Control Program Biological Assessment, which evaluates the potential risk to 198 endangered, threatened, or proposed species in the 17 Cotton Belt States, was prepared according to these guidelines. Because of the large number of species in the control program area, the biological assessment was prepared as a separate document and then submitted to the FWS for review. This appendix is a summary of that document. The FWS will render its Biological Opinion of the assessments, and the Record of Decision for the National Boll Weevil Cooperative Control Program will include FWS findings.

Section 3

Risk Assessment for Federally Listed Endangered, Threatened, and Proposed Species

Introduction

This section describes the methodologies used to assess potential risks to the 198 nontarget organisms listed by the U.S. Fish and Wildlife Service (FWS) as endangered, threatened, or proposed species that may be affected by the four chemical insecticides proposed for use in the National Boll Weevil Cooperative Control Program.

The primary tool in the endangered and threatened species risk assessment was a decision-tree analysis. The decision-tree used specific habitat, diet, and life history information in conjunction with a quantitative risk assessment to determine the potential effect of the control program on each species. The habitat, diet, and life history data were essential for determining whether a species was likely to be exposed to control program insecticides during normal operational procedures. If the possibility of insecticide exposure was positively determined from these data, the quantitative risk assessment was then used to estimate the total dose the species could receive and to gauge what adverse effects, if any, the dose might have on the organism.

Decision-Tree Analysis

Data Accumulation

To assess the risks of the boll weevil control program to the federally listed endangered, threatened, or proposed wildlife species that occur in the program area, information was gathered on the physical characteristics, life histories, habitat requirements, and habitat ranges of the species. Two primary sources were used in the data-gathering process: *Federal Register* notices of the FWS's decision to list the fish, wildlife, and plant species as threatened or endangered under the Endangered Species Act (ESA), and recovery plans published by the FWS for the maintenance and improvement of the species. The *Federal Register* notices contain summaries of a species' physical characteristics, the reasons for its decline, and the FWS's rationale for listing the species.

The FWS recovery plans are much more detailed. They contain more scientific discussions of the information addressed in *Federal Register* notices. Also, the recovery plans contain step-by-step programs that, if successfully executed, should preserve the endangered or threatened species from extinction. The recovery plans usually advocate further study of a species' biological and ecological requirements, maintenance of existing populations, protection of the species' remaining habitat areas, and reestablishment of the species elsewhere in its historical range. The ultimate goal of all recovery plans is removal of the

endangered and threatened species from protected status under the ESA. However, for some species the FWS notes that the small population size or limited habitat areas preclude complete delisting of the species from ESA protection.

Decision-Tree Questions

The decision-tree analysis consisted of a series of five questions posed for each of the 198 endangered, threatened, and proposed species. The decision-tree questions were used to ascertain the following: (1) the occurrence of the species in cotton-producing counties, (2) the proximity of habitat areas to cotton fields or localities affected by cotton production, (3) direct toxicity to the species from insecticide exposure, (4) indirect effects to the species from insecticide application, and (5) the effects of application method disturbances on the species. If the answers to questions 1 or 2 were "no" for a given species, the analysis stopped at that decision point and an assessment of "no effect" was concluded for that species. If the answers to both questions 1 and 2 were "yes," a complete decision-tree analysis was performed for the species and the severity of the impact from insecticide exposure was determined. See figure 3-1 for an illustration of the decision-tree process.

Specifically, the following questions and answers were included in the decision-tree analysis:

Risk Assessment Questions for Endangered, Threatened, and Proposed Species:

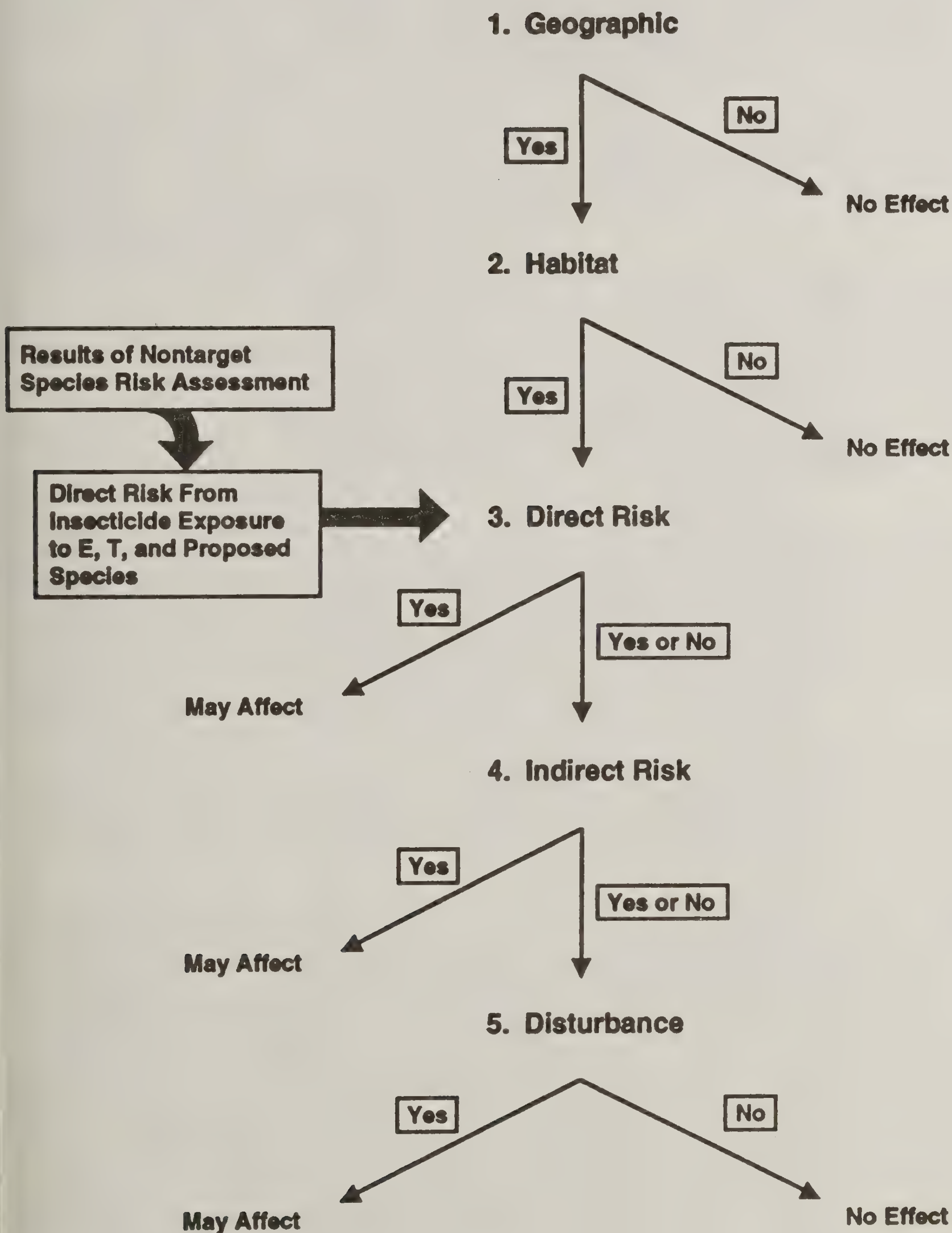
1. Is this species included in both (a) the FWS's "Counties of Occurrence List" or counties cited in the species' Recovery Plans? and (b) the cotton-producing counties APHIS designated for inclusion in the boll weevil cooperative control program?

2. Is this species' habitat located on land or water areas that are in, adjacent to, or close enough to cotton-producing areas to possibly be affected during any part of this species' life cycle?

3. Does any one of the chemicals proposed for use in the boll weevil cooperative control program directly affect this species in any of its life forms? (Direct effect can be through inhalation, dermal, or ingestion exposure for animals; immersion exposure for aquatic forms; or life history stages through phytotoxicity for plants.)

4. Does any one of the chemicals proposed for use in the boll weevil cooperative control program indirectly affect this species in any of its life forms? (Indirect effect can be through effect on its food supply, cover, or reproductive activities for animals; on its pollinators for plants.)

Figure H3-1. Decision Tree Analysis for Endangered, Threatened, and Proposed Species



5. Do the control program application methods disturb this species in any of its life forms throughout its life cycle? (Disturbance may be caused by noise, ground compaction, or mechanical alteration of habitat.)

Risk Assessment Answers for Endangered, Threatened, and Proposed Species:

Impacts were assessed as:

Yes
No
Possible
Unlikely
(F) = future impacts may be possible
-- = this question was not considered because there was no geographic or habitat overlap
? = insufficient information

As explained above, question 1 of the analysis was answered by comparing the FWS's "Counties of Occurrence" list with the list of the cotton-producing counties in the 17 Cotton Belt States. To answer question 2, the species-specific habitat information gathered during the data accumulation process was reviewed and compared with the "Counties of Occurrence" list. If a species' proximity to cotton-growing areas could not be determined from the available information, regional FWS offices were contacted to obtain more specific habitat data. For question 3, the results of a quantitative risk assessment were used to determine the potential risk of direct toxic effects to the species during use of the four proposed boll weevil insecticides. Question 4, or the risk of indirect effects for insecticide use, was answered by analyzing each species' habits, life histories, and diets to determine what effect a short-term loss of preferred diet animals, insect pollinators, or other essential nontarget organisms would have on the species. Similarly, question 5 was answered by reviewing each species' life history and habits to assess the effect of noise, mechanical alteration of habitat, or other disturbances on the species.

Quantitative Risk Assessment

Question 3 of the decision-tree analysis, or the risk of direct toxicity from insecticide exposure, is the key component of the endangered, threatened, and proposed species risk assessment. To answer this question, a quantitative risk assessment was performed. The quantitative risk assessment consisted of three analytic elements: a hazard analysis, an exposure analysis, and a risk analysis. The hazard analysis required gathering information to determine the toxic properties of each of the program insecticides. The nontarget species hazard levels were derived from field toxicity studies and from the results of laboratory toxicity studies of animals, such as rats, mice, rabbits, and fish. The exposure analysis involved estimating potential exposures of nontarget species to the program insecticides and determining what doses were likely to result from those estimated exposures. The risk analysis required comparing the insecticide hazard information with the dose

estimates to predict the toxic effects to wildlife under the specified exposure conditions.

Nontarget Species Hazard Analysis

This section reviews the toxicological information used to determine the potential hazard to nontarget wildlife organisms from the four insecticides—malathion, azinphos-methyl, diflubenzuron, and methyl parathion—considered for use in the program. For each insecticide, results of laboratory and field studies were presented on the insecticide's toxicity to mammals, birds, insects, plants, fish, aquatic invertebrates, aquatic plants, reptiles, and amphibians.

Nontarget Species Exposure Analysis

This section presents the methodology used to estimate exposures to terrestrial wildlife and aquatic species from the four insecticides proposed for use under the preferred alternative in the boll weevil control program.

For assessing the risks to nontarget species in the EIS, exposures were calculated for a group of terrestrial wildlife and aquatic species representative of those that typically inhabit various regions of the Cotton Belt. These species represent a range of animal classes, body sizes, and diets for which biological parameters are generally available. The exposures derived for the representative wildlife species were then assumed to apply to the endangered, threatened, and proposed species evaluated in the biological assessment.

Terrestrial Wildlife Exposure Analysis

In the EIS, typical and extreme exposures were estimated for representative species using conservative assumptions for routine application operations. See appendix B6 for a detailed description of these assumptions and the quantitative methodologies used in the analysis. Also, see appendix B6 for a complete list of the representative species, their body parameters, and their diet items.

However, some additional considerations were needed to complete the endangered, threatened, and proposed species exposure analysis in the biological assessment. For example, each endangered, threatened, and proposed terrestrial species was paired with the representative wildlife species that most closely matched its own body parameters, life history, and diet. Also, the representative species' expected oral doses were considered in the selection process; the most closely related representative species that also had the highest estimated dose was chosen for each of the endangered, threatened, or proposed species reviewed in the biological assessment. For instance, the bald eagle eats fish and rodents; but a species that does not eat fish, the American kestrel, was chosen as the bald eagle's representative species. The provision of the most conservative estimate of risk was the primary reason for this manipulation; the estimated dose for the American kestrel was greater than the dose for the belted kingfisher, the fish-eating bird in the analysis.

Aquatic Species Exposure Analysis

As with the terrestrial representative species, representative aquatic species typically found in the Cotton Belt regions of the United States were used to estimate risks to endangered, threatened, and proposed aquatic organisms. The analysis assumed that the aquatic organisms were exposed to insecticide residues by immersion in water bodies that had received varying levels of insecticide through runoff, drift, or direct spraying.

For each aquatic habitat, the total concentration of each insecticide in water, or the estimated environmental concentration (EEC), was calculated by adding estimated runoff concentrations to drift concentrations. The maximum runoff concentrations possible in the habitats were also calculated. Two quantitative models, the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) and the Exposure Analysis Modeling System (EXAMS), were used to estimate runoff concentrations; a third model, the Agricultural Dispersal Model (AGDISP), was used to estimate drift concentrations from aerial insecticide applications. The GLEAMS model is appropriate for small rivers or streams and uses precise hydrology data and application data, including precipitation runoff, last spray date, and storm date, to estimate runoff concentrations of insecticides. Where specific hydrology data were available for the endangered, threatened, or proposed species examined in the biological assessment, GLEAMS output was calculated separately for each species. If no hydrology data were available for a given species' habitat area, a representative river of similar size and geographic location was selected for the species, and the GLEAMS output for the representative river was assumed to be a reasonable approximation of the insecticide runoff in the water body of concern.

However, because the EXAMS model is most accurate for moderate to large rivers, it was used to calculate runoff concentrations in large-river aquatic habitats. Thus, three large rivers in the Cotton Belt were modeled: the Tennessee River in Alabama and Tennessee, the Alabama River in Alabama, and the Flint River in Georgia. As with the GLEAMS modeling, the EXAMS results for these three rivers were used not only for species that actually exist in them but also for species living in similar rivers that could not be modeled in the analysis. The results of both the EXAMS and GLEAMS models were then added to AGDISP drift estimates to produce a final EEC for each aquatic species. For more detailed descriptions of the EXAMS and GLEAMS models, refer to appendix B8.

In addition to the GLEAMS and EXAMS models, a pond model was used for the aquatic species exposure analysis in the biological assessment. The pond model was used for one amphibian species, the Houston toad, because ponds are the primary breeding areas for this species.

Typical and extreme EECs were calculated for each water body containing endangered, threatened, and proposed aquatic species. In the biological assessment, however, several important revisions were

incorporated into the EEC calculations to make each species' specific analysis as sensitive as possible. In the typical scenario, EECs for each insecticide were calculated from the runoff and drift concentrations of insecticide produced on a watershed basis. In the GLEAMS modeling, the runoff component of the typical EEC was calculated as an 18-hour weighted average of the total insecticide concentration in the watershed divided by the total baseflow in the watershed plus the storm flow. The quantity of aerial spray drift over the entire watershed was then added to the runoff component to determine the final typical EEC. The watershed area upstream from known endangered, threatened, and proposed species habitat and the baseflow for the river or stream segment comprising the habitat, as determined from the U.S. Geological Survey Water Data Report for each State, were used in the calculations. The total mass of insecticide in the watershed was based on the total cotton acreage in the watershed, which was calculated by assuming that the percentage of land devoted to cotton is evenly distributed over each county included in the watershed. The total number of a county's cotton acres in the watershed of concern was calculated from an estimate of the percentage of each county lying within the watershed. After the total number of cotton acres in the watershed of concern was calculated for each county, the ratio of the total cotton acreage in a watershed to the total area of the watershed was calculated, and this percentage was used in the model. It was also assumed that 100 percent of the cotton in any watershed will need treatment at any one time.

In the EXAMS modeling, the runoff output from the model was added to the watershed drift estimates to calculate the typical EEC. For the pond modeling, four different scenarios were used to calculate concentrations of insecticides in a circular pond 1 acre in area and 2 feet in depth. The total runoff to the pond included drainage from 30 acres of cotton field, drainage from three acres of additional area (access roads, buffer areas, and so forth), and the precipitation falling on the pond surface. The following assumptions were used to calculate the insecticide concentrations in each scenario:

> Drift Scenario: Drift concentrations were calculated assuming a buffer of 25 feet between the edge of the field and the edge of the pond. A wind speed of 10 miles per hour was assumed to cause drift on the pond over one-half of its circumference. The area under the drift deposition curve between the two shorelines of the pond was used to determine the total drift per meter of shoreline.
>
> Average Runoff Scenario: Average runoff concentrations were computed assuming that a large storm occurs 2 days after an insecticide application. Because data for storms of varying length and intensity were available, the storm that gave the maximum insecticide concentration in the GLEAMS output was chosen. A total area of 34 acres contributed runoff to the

pond: 30 acres of treated cotton fields, 3 acres of additional land, and the pond itself.

Extreme Runoff Scenario: Extreme runoff concentrations were computed assuming that a small storm occurs on the same day that a cotton field has been treated. This storm is not large enough to produce runoff, but it is large enough to dislodge the insecticide from the foliage. The next day the fields are retreated and a large storm occurs 1 day later. The storm is assumed to be of equivalent magnitude to the storm used in the average runoff scenario. A total area of 34 acres again contributed runoff to the pond, including 30 acres of treated cotton fields, 3 acres of additional land, and the pond itself.

Pond Surface Spray Scenario: Spray concentrations were calculated assuming that a spray plane applies a single swath of insecticide to a farm pond. It is further assumed that all insecticide from the swath lands on the pond surface.

To determine the typical exposure for the pond scenario, the second highest concentration from the drift, average runoff, and extreme runoff scenarios was assumed to represent the typical pond EEC. Because the average runoff scenario produced the second highest concentration for all insecticides, however, the average runoff scenario, in effect, represented the typical case. The pond surface spray scenario was not included in the final assessment of risk because this scenario represents a worst case, accidental situation that should be prevented by proper operational procedures.

In the extreme case, EECs for each insecticide were calculated from the runoff concentrations that would drain from cotton fields located directly upgradient from an aquatic species' habitat and the drift concentrations that would result if drift residues landed directly on the river or stream of concern. In the GLEAMS modeling, the extreme EEC was calculated from the 18-hour weighted average of total insecticide in the watershed plus a "plug" of river or stream water containing the drift concentration. For modeling purposes, a plug was assumed to be a distinct, flowing volume of stream or river water in which the insecticide drift mixes to a uniform concentration. For the EXAMS modeling, the runoff output from the model was added to the plug concentration of drift to derive the total extreme EEC.

In the pond modeling, the highest concentration from the drift, average runoff, and extreme runoff scenarios was assumed to represent the extreme EEC. Because the extreme runoff scenario produced the highest concentration for all insecticides, however, this scenario, in effect, represented the extreme case.

Another addition to the aquatic species exposure analysis in the biological assessment was a maximum runoff concentration scenario. The maximum runoff concentration is the insecticide concentration in the

runoff draining directly off a treated field. This estimate, which is the highest possible estimate of insecticide runoff, was calculated directly from the GLEAMS model. The runoff concentration from GLEAMS was then multiplied by a correction factor to account for the insecticide quantity associated with sediments to derive a final maximum runoff concentration.

A maximum runoff concentration could not be calculated using the EXAMS methodology. Thus, for species in representative EXAMS habitat, qualitative analyses of probable risk were performed.

A concern exists whenever program operations require that aircraft fly near rivers or streams where endangered, threatened, or proposed aquatic species are found. Professional pilots and ground observers are used to avoid impacts to all sensitive areas. Whenever special protection is required for a species' habitat, pilots will fly parallel to the body of water, thereby avoiding the need to turn the aircraft over the water after each pass through the field. Where treatment areas are separated from airports by long expanses of protected rivers or streams, ferrying flights (overflights) will take the most direct route across the river or stream. In most cases this will mean that the flight path will be perpendicular to the stream or river channel. A typical aircraft traveling at 115 miles per hour (169 feet per second) will require less than 2 seconds to cross most streams and waterways in cotton-production areas. It is extremely unlikely that an aircraft would crash or a pesticide be jettisoned during an overflight of a river or stream.

Nontarget Species Risk Analysis

This section considers the potential impacts on federally listed endangered, threatened, and proposed species during use of the insecticides malathion, azinphos-methyl, diflubenzuron, and methyl parathion under the preferred alternative in the National Boll Weevil Cooperative Control Program. Risks to wildlife and aquatic species from boll weevil control with insecticides are directly related to the inherent toxicity (hazard) of each insecticide to different organisms and to the amount of each chemical (dose) those organisms may take in as a result of boll weevil control operations. The wildlife and aquatic species risk analysis compares estimated acute exposures of representative species with the acute toxicity levels found in laboratory studies.

Wildlife Risk Analysis

For wildlife risks, the criterion the Environmental Protection Agency (EPA) uses in its ecological risk assessment (EPA, 1986) of endangered species was used to determine risks to the different representative species and the relative risks among the four insecticides. The EPA criterion calls for a comparison of the dose received by an animal with the laboratory-determined LD_{50} for the most closely related laboratory test species.

For endangered, threatened, and proposed terrestrial wildlife species, EPA (1986) considers the risk unacceptable if the dose exceeds 1/10 the LD_{50}. (LD_{50} means medium lethal dose. It is the dosage of toxicant, expressed in milligrams per kilogram of body weight (mg/kg), required

to kill 50 percent of the animals in a test population within 14 days of administration.) Doses below this level are assumed to present a low or negligible risk.

Toxicity Surrogates

For the wildlife risk assessment in the EIS, species that represent the wildlife commonly found in the program regions were identified, and the doses they could receive from exposure to the four insecticides were calculated in the exposure analysis. In some cases, however, information was not available on the doses that would cause toxicity to these representative species. Therefore, it was necessary to select a closely related species for which toxicity data were available. For example, the belted kingfisher was selected as a common fish-eating bird throughout the Cotton Belt regions, but because toxicity data were not available for that species, the mallard duck was identified as closely related and data for it were used in the risk calculations. In the biological assessment, the direct toxicity of the four program insecticides to endangered, threatened, and proposed species was evaluated by assuming that the doses calculated, on a per body weight basis, for the representative species also applied to the endangered, threatened, and proposed species.

See appendix B7 for a complete discussion of the toxicity surrogates for mammals, birds, amphibians, and reptiles.

Aquatic Species Risk Analysis

To estimate the susceptibility of the endangered, threatened, and proposed aquatic species to the program insecticides, each species was paired with a common aquatic species for which acute toxicity reference values (LC_{50}s) have been determined. (An LC_{50} is a concentration of a substance in water, expressed in milligrams per liter (mg/L), at which 50 percent of the test animals will be killed. The LC_{50} can be computed on a 24-, 48-, or 96-hour basis.) The aquatic species most sensitive to the four insecticides were selected in each case. The toxicity reference values were then compared with the EECs and the maximum runoff concentrations of each insecticide. According to EPA (1986), the risk to endangered aquatic species is unacceptable if the EEC equals or exceeds 1/20 the LC_{50}.

The typical and extreme EECs were compared to 96-hour LC_{50}s, because the EECs may persist up to 2 days in a water body. However, the maximum runoff concentrations were compared to 96-hour LC_{50}s, where available, because a maximum runoff event should not last more than 12 hours on an individual field.

For fish, the sensitive species used in the analysis included the bluegill, with a 96-hour LC_{50} of 0.020 mg/L for malathion; the yellow perch, with 96-hour LC_{50}s of 0.0024 mg/L for azinphos-methyl and 3.060 mg/L for methyl parathion; and the channel catfish, with a 96-hour LC_{50} of 370 mg/L for diflubenzuron. Also, the sensitive fish species used in the maximum runoff concentration analysis included

the bluegill, with a 24-hour LC_{50} of 0.070 mg/L for malathion; the black crappie, with a 24-hour LC_{50} of 0.0047 mg/L for azinphos-methyl; and the yellow perch, with a 24-hour LC_{50} of 4.930 mg/L for methyl parathion. No 24-hour LC_{50}s for diflubenzuron were available. It was assumed that these toxicity values approximate the toxicity of the insecticides to the endangered, threatened, and proposed fish species evaluated in this assessment.

Toxicity Surrogates

No information was available on the toxicity of the four boll weevil control program insecticides to freshwater clams. However, the American oyster, a saltwater bivalve species, was used as a toxicity surrogate for the effects of malathion and azinphos-methyl on the endangered, threatened, and proposed freshwater mussel species in the program area. The following 48-hour median threshold limits for the American oyster were used in the analysis: 9.070 mg/L for malathion and 0.620 mg/L for azinphos-methyl. For the effects of diflubenzuron and methyl parathion on freshwater clams, fish were used as toxicity surrogates because evidence suggests that known fish toxicants are comparatively less toxic to freshwater mussels during acute exposure (Havlik and Marking, 1987). Thus, using fish as toxicity surrogates is a conservative assumption that will likely overstate the risk to freshwater mussels. The channel catfish, with a 96-hour LC_{50} of 370 mg/L for diflubenzuron, and the yellow perch, with a 96-hour LC_{50} of 3.060 mg/L for methyl parathion, were the toxicity surrogates used in the analysis. Because no 24-hour LC_{50}s were available for freshwater clams, the toxicity surrogates used in the EEC analysis were also used in the maximum runoff analysis.

As with the freshwater clams, no information was available on the toxicity of the control program insecticides to aquatic reptiles. However, juvenile amphibians and a fish species were used as toxicity surrogates because such organisms are likely more susceptible to insecticide exposure than aquatic reptiles. Aquatic reptiles possess highly impervious shells (turtles) and scales (snakes and turtles) that reduce the possibility of a dermal dose. However, tadpoles and fish have more permeable skin. Consequently, the use of such organisms as toxicity surrogates is a conservative assumption that probably overstates the risk of insecticide exposure to aquatic reptiles. In the EEC analysis, the tadpole of the western chorus frog was used as the toxicity surrogate for malathion and methyl parathion; the 96-hour LC_{50} for malathion was 0.200 and for methyl parathion, 3.70 mg/L. The tadpole of Fowler's toad, with a 96-hour LC_{50} of 0.109 mg/L for azinphos-methyl, and the channel catfish, with a 96-hour LC_{50} of 370 mg/L, were also used as toxicity surrogates. In the maximum runoff analysis, the tadpole of the western chorus frog again was the toxicity surrogate for malathion and methyl parathion; the 24-hour LC_{50} for malathion was 0.560 and the 24-hour LC_{50} for methyl parathion was 7.6 mg/L. The tadpole of Fowler's toad, with a 24-hour LC_{50} of 0.710 mg/L for

azinphos-methyl, also was a toxicity surrogate for aquatic reptiles. However, no 24-hour LC_{50}s were available for diflubenzuron.

Section 4

Descriptions and Analyses of Example Endangered, Threatened, and Proposed Species

Introduction

The biological assessment analyzed the potential effects of the National Boll Weevil Cooperative Control Program on 198 nontarget organisms, including mammals, birds, reptiles, amphibians, fish, clams, insects, arachnids, a crustacean, and a snail, as well as plants listed by the U.S. Fish and Wildlife Service (FWS) as endangered, threatened, or proposed species. Of the 198 species, 85 were considered "may affect" species, or species that may be adversely affected by direct or indirect toxic effects of insecticide use; and the remaining 113 species were designated as "no effect," or species whose life histories, diets, or habitat requirements preclude any threat of insecticide exposure. See attachment A for a complete list of the endangered, threatened, and proposed species known to exist in cotton-growing areas. Also, see table 4-1 for a summary of the total "may affect/no effect" risk determinations within each taxa.

The biological assessment contained species descriptions for 198 species; 5 species were discussed under the description of a closely related species or subspecies. For example, the California brown pelican (*Pelecanus occidentalis californicus*) was discussed in the description for the brown pelican (*Pelecanus occidentalis*). Each species description contained eight topic headings: status, description, habits, habitat, factors in species decline, recovery plan, analysis of program impacts, and conclusion. A species' status refers to its official FWS designation as an endangered, threatened, or proposed species. The date of the species' listing was also given in the status section.

As the titles of each section indicate, the description, habits, habitat, factors in species decline, and recovery plan sections detailed an animal or plant's size, appearance, life history, diet, habitat requirements, the known or suspected causes of the species' decline, and a brief summary of the FWS' plan for maintaining and ultimately enhancing the species. The analysis of program impacts section provided a synopsis of each species' decision-tree analysis; it summarized the likelihood that a species would be exposed to unacceptable levels of insecticide during normal control program operations and evaluated the potential for direct or indirect toxic effects from insecticide exposure or mechanical disturbances. For "may affect" species, the analysis of program impacts section described the measures that should protect the species from unacceptable risk.

For terrestrial species, the protection measures may involve establishing buffers that limit insecticide applications within a specified distance of known endangered, threatened, or proposed species' habitat. Buffers were based on the distance that would effectively minimize direct or

Table 4-1. Summary of Potential Risks from Implementing the Proposed National Boll Weevil Cooperative Control Program

Taxa	May affect	No effect	Total species
Mammals	6	14	20
Birds	14	9	23
Reptiles	9	2	11
Amphibians	1	3	4
Fish	19	17	36
Clams	24	4	28
Crustaceans	1	0	1
Insects	0	4	4
Snails	1	1	2
Arachnids	0	3	3
Plants	10	56	66
Total	85	113	198[a]

[a] Five species' discussions were incorporated in other species' discussions. For example, the California brown pelican was discussed in the assessment of the brown pelican.

indirect risk from spray drift. The spray drift modeling indicated that, even under 10-mile-per-hour crosswinds, spray deposition beyond 50 feet from the flight line attenuates rapidly.

For species where protection was required to minimize the risk of direct exposure to any of the program insecticides, a 200-foot buffer was considered appropriate. For species such as insectivorous birds or plants pollinated by insects where protection was deemed necessary to minimize any potential effects on insect prey or insect pollinators, a 300-foot buffer was considered appropriate.

The protection measures for aquatic species are more complex, however, because such species could be exposed to both drift and runoff concentrations of insecticide. For example, when a typical EEC exceeded the risk criterion of 1/20 the LC_{50}, the percentage of cotton sprayed with the insecticide in question was decreased until the concentration dropped below the risk level. This percentage was then back calculated to determine the maximum number of acres that can safely be treated with that insecticide in the watershed. When an extreme concentration exceeded the risk criterion, drift buffers of 200 feet for aerial applications and 50 feet for ground applications were prescribed. These buffers were sufficient to reduce the "plug" drift concentration below the risk level for all endangered, threatened, and proposed species.

If the maximum runoff concentration of a given insecticide exceeded the risk criterion, the minimum distance upgradient below which applications of the insecticide should be prohibited was determined.

To calculate this upgradient distance, several components of the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) modeling were incorporated into a protection model, including the stream depth, the inches of runoff from the field, and the size of the adjacent cotton fields. The protection model also assumed that a runoff event lasted for 12 hours. Using these parameters, the flow rate of runoff from the field was calculated and the flow was assumed to enter the river or stream of concern. As the flow entered the water, the stream's baseflow was assumed to dilute the concentration of insecticide as it flowed downstream. Specifically, the section of the stream encompassed by the shape of a prism was assumed to represent the mixing of baseflow and field runoff. The dimensions of the prism were calculated by assuming that the shear velocity of the stream is equal to 8 percent of the downstream velocity. The distance downstream was then calculated by determining the water volume necessary to dilute the field runoff to a concentration below the risk level. At this volume, the distance downstream is the "height" of the prism. When the base of the prism exceeded the width of the stream, the entire volume of the stream was used to represent the mixing of base flow and field runoff and thus the volume of the stream plus the initial prism were used to calculate the upgradient distance.

Another protection measure intended to avoid insecticide contamination of aquatic habitats, developed as a result of the runoff analysis for the biological assessment, involves weather monitoring to predict significant storms. Rainstorms of sufficient intensity to produce contaminated runoff immediately after a cotton field is treated with insecticide occur infrequently during a growing season. In fact, the storms that produced the highest insecticide concentrations in the biological assessment's aquatic analysis occurred on an average of only once every 2 years. Thus, the monitoring of weather conditions and the cessation of all spraying operations within 24 hours of significant rainfall events will greatly limit the possibility that damaging levels of insecticide-contaminated runoff would reach sensitive aquatic habitats.

Whatever protection measures are chosen for each endangered, threatened, or proposed species, implementation of these strategies will require close field-level cooperation between APHIS and FWS to identify current species' locations and to tailor the control program operations to protect these species. The location of many species is often a dynamic factor dependent on climate, species migration, and natural forces, such as fire, floods, and severe weather. The location of individual cotton fields is also a dynamic factor dependent on weather and market economics. The dynamics of both species locations and cotton production must be closely monitored to avoid species impact.

Example Species Descriptions

The example species descriptions that follow illustrate the diversity and wide geographical distribution of endangered, threatened, and proposed species in the Cotton Belt, the scope of potential risks posed to the species by the control program, and the specific protection measures devised to prevent insecticide exposure. Species from various animal

and plant taxa were chosen from each of the Cotton Belt's three primary regions—the Southeast, South Central, and Southwest. The potential risks to these species range from negligible adverse effects to direct threats of toxic exposure to specific control program insecticides. The protection measures include maintaining buffers of varying size, imposing equipment restrictions, restricting ferrying aircraft flights over known habitat areas, and prohibiting certain insecticides near species' habitat.

Note that "may affect" and "no effect" species descriptions are presented for seven taxa: mammals, birds, reptiles, fish, clams, plants, and amphibians. A "no effect" species description is also presented for an insect; no insects were designated as "may affect" species in the biological assessment. The species description for a "may affect" crustacean, the Alabama cave shrimp, is also included; no crustaceans were designated as "no effect" species in the biological assessment.

Mammals

May Affect

***Myotis grisescens*—Gray bat**

Status. The gray bat was listed as endangered on April 28, 1976 (41 FR 17740, April 28, 1976).

Description. The gray bat is the largest member of its genus in the Eastern United States. Its forearm measures 1.5 to 1.8 inches (40 to 46 mm), and it weighs from 0.3 to 1 ounce (7 to 16 g). It is easily distinguished from all other bats within its range by its unicolored dorsal fur, because all other eastern bats have distinctly bi- or tricolored fur on their backs. Following molt in June or July, gray bats are dark gray, but they often bleach to chestnut brown or russet between molts, especially reproductive females during May and June. The wing membrane connects to the foot at the ankle rather than at the base of the first toe, as in other species of *Myotis* (FWS, 1982a).

Habits. Gray bats feed on insects. During peak insect abundance in early evening, many gray bats feed in slowly traveling groups, but when insect activity subsides 1 to 2 hours after sundown, the bats become territorial. Depending on prey abundance, foraging territories may be occupied by from 1 to as many as 15 or more bats. Territories seem to be controlled by reproductive females and are located in the same places and used by the same individual bats from one year to the next. Most migrate seasonally between hibernating caves and maternity caves. On arrival at hibernating caves, the adults mate, and the females immediately begin hibernation, some as early as the first of September and nearly all by early October. After mating, the males remain active for several weeks, during which time fat supplies depleted during breeding are replenished. The juveniles of both sexes and adult males tend to enter hibernation several weeks later than the adult females, but most are in hibernation by early November. Stored fat reserves must last for at least 6 to 7 months. The adult females

store sperm throughout the winter months and become pregnant soon after they emerge from hibernation. The adult females emerge in late March or early April, followed by the juveniles of both sexes and the adult males. Migration is hazardous, especially in spring when fat reserves and food supplies are low. Consequently, adult mortality is especially high in late March and in April. The pregnant females give birth to a single young in late May or early June. At that time, the reproductively active females congregate in a single, traditional maternity cave (usually the warmest one available), while males and nonreproductive females congregate in smaller groups in more peripheral caves within the colony home range. Most young begin to fly 20 to 25 days after birth. Each summer colony occupies a traditional home range that often contains several roosting caves scattered along as much as 43.5 miles (70 km) of river or reservoir borders. Colony members are extremely loyal to their colony home range, but they tend to disperse in groups among several different caves within that area.

Habitat. Most winter caves are deep and vertical; all provide large volume below the lowest entrance and act as cold air traps. A much wider variety of cave types is used during the spring and fall transient periods. In summer, maternity colonies prefer caves that act as warm air traps or that provide restricted rooms or domed ceilings that are capable of trapping the combined body heat from thousands of clustered individuals. During all seasons, males and yearling females seem less restricted to specific cave and roof types. Summer caves, especially those used by maternity colonies, are nearly always located within a kilometer of the rivers or reservoirs over which the bats feed. Newly volant young gray bats often feed and take shelter in the forest surrounding the cave entrances. Forested areas surrounding caves and between caves and overwater feeding habitat clearly are advantageous to gray bat survival. The bat is found in limestone karst areas of the Southeast—in Alabama, Arkansas, Missouri, Florida, and Tennessee. There is no federally designated critical habitat for the gray bat. Important habitats in Alabama are Fern and Sauta Caves in Jackson County, Cave Springs Cave in Morgan County, Key Cave in Lauderdale County, Georgetown Cave in Colbert County, Hambrick Cave in Marshall County, and Sanders Cave in Conecuh County. Other important caves are Old Indian, Geromes, Judges, and Girards Caves in Jackson County, Florida. The FWS' "Counties of Occurrence" list includes 11 counties in Alabama, 6 counties in Florida, 3 counties in Georgia, and 6 counties in Tennessee.

Factors in Species Decline. The reasons for the gray bat's decline include human disturbance (entrance into caves during hibernation), environmental disturbance (pesticide use, chemical pollution, siltation of waterways over which gray bats forage, and deforestation leading to increased predation), impoundment of waterways, cave commercialization, improper gating, and natural calamities (cave flooding and cave-ins) (FWS, 1982a).

Recovery Plan. The objective of the recovery plan is to remove the gray bat from endangered status (FWS, 1982a). The criteria for change from endangered to threatened status are documentation of protection of 90 percent of the Priority 1 hibernacula and documentation of stable or increasing populations at 75 percent of Priority 1 maternity caves during a period of 5 years. Once the status has been changed from "endangered" to "threatened," it will be possible to delist this species by the documentation of permanent protection as well as stable or increasing populations during 5 years of 25 percent of Priority 2 caves in each State. The most important feature of this plan is protecting the roosting habitat, but it also includes maintaining, protecting, and restoring the forage habitat and monitoring population trends.

Analysis of Program Impacts. Because they roost in caves during the day and foraging is crepuscular and nocturnal, direct toxic insecticide exposures of gray bats are not likely to occur. Depletion of their insect food supplies could be a problem only if accidental overspraying or significant drift of insecticides occurred during applications to cotton fields next to the streams, rivers, and lakes where the bats are known to forage. In known foraging areas, risks will be decreased by using only ground equipment for insecticide applications within 200 feet (61 m) of identified riparian areas. Bat colonies roosting in caves could be disturbed by aircraft overflights. To prevent this disturbance, aircraft overflights of identified roosting caves will be avoided. Although direct exposure to malathion, azinphos-methyl, or methyl parathion may present a risk to the species, such occurrences are extremely unlikely because the bats roost in caves.

Conclusion. May affect.

No Effect

***Felis concolor couguar*—Eastern cougar**

Status. The eastern cougar was listed as endangered on March 11, 1967 (32 FR 4001; March 11, 1967).

Description. The eastern cougar is a large tawny to grayish cat, with dark brown on the tip of its tail and on the back of its ears. Its eyes are greenish gold. Its body length (including head) is 42 to 54 inches (107 to 137 cm), and its tail is 32 to 36 inches (81 to 91 cm). The cat's height at the shoulder is approximately 26 to 31 inches (66 to 79 cm), and it weighs 80 to 200 pounds (36 to 91 kg). The young are spotted in color.

Habits. The cougar is chiefly nocturnal. This species feeds on deer, rodents, and occasionally domestic animals. Cubs may be born in any month, one to four in a litter. Cougars have large territories, often roaming up to 100 miles from where they are born.

Habitat. The eastern cougar was originally found in South Carolina, Tennessee, Kentucky, Indiana, and all States east and north. They

prefer rugged mountains, forests, and swamps away from humans. Cougars may still survive in a few inaccessible localities—possibly the Jefferson, George Washington, and Monongahela National Forests in West Virginia and Virginia; parts of Pennsylvania, New England, and several Canadian provinces; and the mountains and swamps of North Carolina. The FWS' "Counties of Occurrence" list includes Chesterfield and Greenville Counties, South Carolina, and Chattooga and Floyd Counties, Georgia.

Factors in Species Decline. The cougar was feared by early settlers, who quickly eliminated it from most regions. Bounties were offered for cougars until the late 19th century. No breeding populations have been substantiated since the 1920s.

Recovery Plan. The recovery plan was written in 1982 (FWS, 1982b). Its objective is three self-sustaining populations of 50 breeding adults. Because this goal is unlikely to be reached, a more immediate goal is to locate a wild population. If a wild population is found, the next steps are to study and protect this population and to implement permanent management programs.

Analysis of Program Impacts. The eastern cougar should not be affected by the boll weevil program because its secretive habits and preference for remote habitats preclude its living near cotton fields.

Conclusion. No effect.

Birds

May Affect

***Vireo atricapillus*—Black-capped vireo**

Status. The black-capped vireo was listed as endangered on November 5, 1987 (52 FR 37423, October 6, 1987).

Description. The black-capped vireo is a 4.5-inch insectivorous bird. It is olive green, with white beneath, greenish-yellow flanks, and a white crown. The females are duller in color (52 FR 37423, October 6, 1987).

Habits. The black-capped vireo builds a cup nest made of bark, grass, and leaves, lined with fine grass, in short trees. The female has two broods of four eggs each year. Its diet consists of insects, seeds, and bark (Ehrlich et al., 1988).

Habitat. The bird's preferred habitat is scattered trees in brushy areas where woody vegetation is found in clumps. Nests are mostly found 16 to 49 inches from the ground, in blackjack oak *(Quercus marilandica)*, Shumard oak *(Quercus shumardii texana)*, post oak *(Quercus stellata)*, and sumac *(Rhus virens)*. This habitat is often located on steep slopes, where the shallow soils and harsh environment allow for slow succession. Other preferred habitats are maintained by wildfires and wildlife grazing. The vireo's current breeding range extends from Oklahoma,

through Texas, to Sierra Madera, Mexico (52 FR 37423, October 6, 1987). The FWS' "Counties of Occurrence" list includes Blaine, Caddo, Canadian, and Comanche Counties in Oklahoma, and Bexar, Kinney, and Uvalde Counties in Texas.

Factors in Species Decline. The primary cause of the black-capped vireo's decline is habitat destruction through domestic overgrazing and rangeland improvements. Cowbird nest parasitism is also a factor in the decline of this species.

Recovery Plan. None.

Analysis of Program Impacts. According to the results of the terrestrial wildlife risk assessment, direct exposure to malathion, azinphos-methyl, or methyl parathion presents an unacceptable risk to the black-capped vireo where the species' habitat lies adjacent to cotton fields. An appropriate protection measure in fields adjacent to known vireo habitat is to emphasize the use of diflubenzuron and to avoid aerial application within 200 feet (61 m) of known habitat where only ground applications will be made.

Conclusion. May affect.

No Effect

***Pelecanus occidentalis*—Brown pelican**
(Also included in this discussion is the California brown pelican, *Pelecanus occidentalis californicus*)

Status. The brown pelican was listed as endangered on October 13, 1970 (35 FR 16047, October 13, 1970; 35 FR 8495, June 2, 1970). The Alabama, Florida, Georgia, South Carolina, and North Carolina populations were delisted on February 4, 1985 (50 FR 4945, February 4, 1985).

Description. The brown pelican is a dark-brown water bird with white bands around the head and neck. Immature birds have a dark head and a white underside. The pelican has a distinctive bill and a throat pouch. This species can weigh up to 8 pounds (3.6 kg) and may have a wingspan of 7 feet (2.1 m) (Peterson, 1980).

Habits. Pelicans are colonial; they nest on small coastal islands in the available vegetation. Nests are built of sticks, reeds, and grasses. Pelicans lay three eggs, and the altricial young are fledged at 11 to 13 weeks of age (FWS, 1979). The pelican feeds on fish caught by diving and may rely on anchovies during the breeding season (Ehrlich et al., 1988).

Habitat. The habitat needs for the brown pelican are predator-free nesting areas, adequate offshore food supplies, and roosting sites. Nests can be built in mangrove trees or, provided the area is isolated from potential predators, on the ground using available vegetation.

The quality of the offshore sites is important to breeding success; the offshore rocks and islands, pilings, and jetties near nesting sites are important roosting areas (FWS, 1983a). The eastern population of brown pelicans is still endangered in Texas and Louisiana, while the California population is endangered throughout its habitat. Although the California brown pelican is found predominantly along coastal regions, individuals may venture inland along the Colorado River (Peter Stine, personal communication). The FWS' "Counties of Occurrence" list includes 10 counties in Texas and Imperial and Riverside Counties, California.

Factors in Species Decline. The decline of the California population (*Pelecanus occidentalis californicus*) of the brown pelican was precipitated by a near total reproductive failure in the 1950s and 1960s as eggshells became increasingly thin and susceptible to breakage. High concentrations of the pesticide DDT have been implicated in eggshell thinning (FWS, 1983a). In the Southeast, the decline has been blamed on weather, predation, starvation, and vandalism. DDT and other pesticides have not been conclusively linked to the decline of the eastern populations (FWS, 1979).

Recovery Plan. The primary objective of the eastern plan is the prevention of the extirpation of the eastern brown pelican from its historic range. Recovery actions include restoration of the pelican in vacant nesting habitat and maintenance of these colonies through natural reproduction (FWS, 1979). The objective of the California plan is the restoration and maintenance of stable populations throughout the species' historic range. This can be accomplished through the maintenance of existing populations in Mexico, the protection of food supplies and habitats, and the restoration of the species in southern California (FWS, 1983a).

Analysis of Program Impacts. The brown pelican is not at risk from the boll weevil program because its habitat preference and feeding habits are not associated with cotton production in any way.

Conclusion. No effect.

Reptiles

May Affect

***Uma inornata*—Coachella Valley fringe-toed lizard**

Status. The Coachella Valley fringe-toed lizard was listed as threatened on October 27, 1980 (45 FR 63812, September 25, 1980).

Description. This is a medium-sized lizard that attains an adult length of 5.9 to 9.4 inches. The tail constitutes 49 to 64 percent of the total length. The dorsal areas are whitish to pale gray with patterns of occelli, or eyelike markings, that form longitudinal stripes over the shoulders. The ventral surface is white, and one or more black dots are present on each side of the abdomen. The smooth, overlapping scales

give the skin a velvety texture, and a lateral row of elongated scales are present on the posterior edge of the toes (FWS, 1984a).

Habits. The smooth scales and the fringed toes enable the lizard to move quickly over sand and, when necessary, to dive into the sand and bury itself completely. As with other desert lizards, the behavioral patterns of the fringe-toed lizard are temperature dependent; the species is active in air temperatures 3 feet (1 m) above ground between 47 to 83°F (22 to 39°C) and ground-surface temperatures of 78 to 125°F (37 to 59°C) (Turner et al., 1981; as cited in FWS, 1984a). During periods of extremely hot temperatures, the species exhibits bimodal activity, moving only during the cooler early and late hours of the day. The lizard feeds primarily on insects that congregate near flowering vegetation, but it will also consume plant material (FWS, 1984a).

Habitat. Semiarid areas with deposits of fine wind-blown sand are the Coachella Valley fringe-toed lizard's preferred habitat. Critical habitat has been established in the Coachella Valley of Riverside County, California (45 FR 63812, September 25, 1980). The critical habitat area involves more than 12,000 acres (4,900 hectares) of land, most privately owned, and extends past the northern boundary of the lizard's geographical range to include sources of sand essential for the wind-blown sand habitat (FWS, 1984a).

Factors in Species Decline. To protect residential and agricultural areas from blowing sand, local governments, developers, and individuals have planted tamarisk windbreaks. These windbreaks also prevent blowing sand from reaching the fringe-toed lizard's habitat, and ultimately the downwind habitat is eroded. The loss of habitat through urban and agricultural development and the construction of windbreak structures have facilitated the decline of the Coachella Valley fringe-toed lizard. In addition, the introduction of exotic vegetation, such as the Russian thistle (*Salsola iberica*), has contributed to the decline by obstructing the movement of windblown sand and by stabilizing sand dunes. Finally, excessive collecting of the lizard and the reduction of food sources by agricultural pesticides are also suspected of affecting the species (FWS, 1984a).

Recovery Plan. The recovery objective is to preserve the species by effectively controlling two or more protected areas in the historic range (one area is the designated critical habitat) that support viable populations of the lizard. The ultimate goal is to remove the species from the Federal threatened species list. The plan also calls for studying the lizard's biological and habitat requirements, the effects of habitat modification, and the feasibility of reintroduction programs and establishing population monitoring and public information programs (FWS, 1984a).

Analysis of Program Impacts. Based on the results of the terrestrial wildlife risk assessment, direct exposure to malathion, azinphos-methyl, or methyl parathion presents an unacceptable risk to the Coachella

Valley fringe-toed lizard. Thus, the lizard may be at risk in areas where cotton fields are located adjacent to its habitat. Also, the species may be affected by depletion of its insect food supply if offsite drift occurs. To protect the species and its insect food supply, APHIS will avoid aerial applications within 300 feet (91 m) of known lizard habitat within Riverside County, California. Within this buffer, only ground equipment will be used.

Conclusion. May affect.

No Effect

***Lepidochelys kempii*—Kemp's ridley sea turtle**

Status. Kemp's ridley sea turtle was listed as endangered on December 2, 1970 (35 FR 18320, December 2, 1970).

Description. As is characteristic of marine turtles, the Kemp's ridley sea turtle has a large body, a thick, nonretractable head, and paddle-like limbs for swimming (NMFS, 1984).

Habits. This sea turtle is a migratory species that inhabits open waters for much of the year before returning to land for the nesting season. The species has a high reproductive potential; each nesting female lays about 100 eggs, and multiple nestings per season are common (NMFS, 1984).

Habitat. This sea turtle's preferred nesting areas are stable—rock-strewn beaches where primary successional vegetation grows along the berm and dunes vegetated with a climax community of shrubs and small trees. A beach adjacent to Barra Coma, a sandbar on Mexico's Tamaulipas coast near Rancho Nuevo, Municipio de Aldama, is the only remaining nesting habitat. A few nestings were previously recorded on Padre Island, Texas, but such sightings were rare, and apparently the island was never a preferred nesting area. Although the species' primary sea habitat is the Gulf of Mexico, its feeding range extends into Atlantic waters and includes American territory (NMFS, 1984). The FWS' "Counties of Occurrence" list includes Bryan County, Georgia.

Factors in Species Decline. Today, less than 1,000 Kemp's ridley nests are observed each season on the Rancho Nuevo beach. The elimination of nesting areas through coastal development, beach mining for sand, and deleterious erosion control measures is the primary cause of the decline. However, degradation of the sea habitat has also contributed to the population drop. Pollution from industrial and residential development, exploratory oil and gas drilling, disposal of garbage at sea, and the proliferation of power boats is suspected of reducing habitat quality and, ultimately, Kemp's ridley populations (NMFS, 1984).

Recovery Plan. The Marine Turtle Recovery Plan calls for restoring Kemp's ridley sea turtle populations to a level comparable to the 1940s level of 40,000 nesting females (Carr, 1963; as cited in NMFS, 1984). To achieve this goal, the plan includes regulating the petrochemical industry and developing comprehensive oil spill contingency plans, maintaining the nesting beach as a wildlife preserve, using hatcheries to develop new populations, maintaining beach patrols to prevent poaching or collecting, and monitoring populations and reproductive success (NMFS, 1984).

Analysis of Program Impacts. Because the Kemp's ridley sea turtle does not nest in the United States and spends most of the year in open waters, the species' habitat will not be affected by the boll weevil control program. Although pesticides that enter major rivers through runoff may ultimately reach the sea, dilution of these pesticides will effectively eliminate any direct or indirect toxicological threat.

Conclusion. No effect.

Amphibians

May Affect

***Bufo houstonensis*—Houston toad**

Status. The Houston toad was listed as an endangered species on October 13, 1970 (35 FR 16047, October 13, 1970).

Description. The Houston toad is a small- to medium-sized toad; the males attain a snout-vent length of 1.8 to 2.7 inches (45 to 70 mm), while the females usually reach 2 to 3.1 inches (52 to 80 mm). The dorsum is light brown, sometimes reddish, with dark brown to black spots. These spots often contain a single or fused nonspinsous wart. The venter is cream colored and usually contains at least one brown spot in the pectoral area. The paratoid glands are elongated (FWS, 1984c).

Habits. Mature Houston toads feed primarily on various insect species and small toads; tadpoles probably consume pollen and algae. The species breeds in rain pools, flooded fields, and natural and humanmade ponds (FWS, 1984c).

Habitat. Adult Houston toads prefer habitat areas with sandy soils and a forest cover interspersed with open grassy areas. A pine or mixed deciduous system is the preferred forest. The species is believed to exist only in Harris, Bastrop, and Burleson Counties, Texas (FWS, 1984c). Critical habitat areas have been designated in Bastrop and Burleson Counties (43 FR 4022, January 31, 1978). The FWS' "Counties of Occurrence" list also includes Colorado County, Texas, because of its historical cotton production. However, Colorado County did not produce cotton in 1985, 1986, or 1987.

Factors in Species Decline. Alteration of the preferred forested, sandy soil habitat areas through urban and agricultural development has facilitated the decline of the Houston toad. The concomitant construction of highways and roads has also destroyed habitat and increased highway mortality. Other suspected threats include the use of herbicides along highways and of fertilizers, herbicides, and pesticides on adjacent agricultural areas, overgrazing, and forest fires (FWS, 1984c).

Recovery Plan. The ultimate goal of the Houston Toad Recovery Plan is to improve the condition to nonthreatened status. The species will be considered for downlisting when moderately sized, self-sustaining populations exist in two or more Texas counties in addition to Bastrop and Burleson Counties and when the long-term survival of the populations in Bastrop and Burleson is ensured. The complete delisting of the species will be considered when self-sustaining breeding populations exist in five or more counties. To achieve this goal, the plan calls for protecting known populations and habitat areas, searching for and protecting additional natural populations and habitat, clarifying the toad's taxonomic status, and introducing and establishing self-sustaining populations in the toad's historic range (FWS, 1984c).

Analysis of Program Impacts. The Houston toad may be affected by the boll weevil control program if cotton fields occur immediately adjacent to its known critical habitats in Texas. Furthermore, the terrestrial wildlife risk assessment indicates that direct exposure to azinphos-methyl and methyl parathion presents an unacceptable risk to the species. The aquatic risk assessment indicates that malathion and azinphos-methyl present an unacceptable risk to tadpoles in ponds receiving runoff from the entire pond drainage area. To protect the Houston toad, APHIS will avoid the use of azinphos-methyl and methyl parathion in cotton fields adjacent to Houston toad habitat in the Texas counties of Harris, Bastrop, Burleson, and Colorado, and avoid the use of malathion and azinphos-methyl in the drainage area of any known breeding ponds.

Conclusion. May affect.

No Effect

Typhlomolge rathbuni—Texas blind salamander

Status. The Texas blind salamander was listed as endangered on March 11, 1967 (32 FR 4001, March 11, 1967).

Description. This salamander is 3.25 to 4.25 inches (8.3 to 10.8 cm) long, with thin legs and a flattened snout. Remnants of eyes appear as dark spots under the skin. This species retains its larval form, has pink, external gills throughout its life, and is white or pinkish in color (32 FR 4001, March 11, 1967).

Habits. As a troglodytic species, the Texas blind salamander lives in total darkness. The diet of the Texas blind salamander is unknown, but all other salamanders are meat eaters or scavengers (32 FR 4001, March 11, 1967).

Habitat. This species is found in underground streams along the escarpment that separates the Edwards Plateau from the prairies and flatlands to the east (32 FR 4001, March 11, 1967). The FWS' "Counties of Occurrence" list includes Hays County, Texas.

Factors in Species Decline. No information is available.

Recovery Plan. None.

Analysis of Program Impacts. Although the terrestrial wildlife risk assessment indicates that direct exposure to azinphos-methyl or methyl parathion presents an unacceptable risk to the Texas blind salamander, the species' habitat requirements make exposure to drift or direct spray highly unlikely. The only circumstance in which the salamander could face a risk of insecticide exposure would be if the underground streams encompassing its habitat were contaminated by insecticide. For example, a large insecticide spill in a groundwater recharge area upgradient of the salamander's habitat could expose the species to toxic concentrations of insecticide. Standard operating procedures for the boll weevil program incorporate adequate procedural safeguards for mixing, loading, and storing insecticides. The procedures also guide program personnel in the proper handling of emergency spills and disposal of insecticide containers. The use of these procedures will ensure that there is no effect on the Texas blind salamander.

Conclusion. No effect.

Fish

May Affect

Cyprinodon macularius—**Desert pupfish**

Status. The desert pupfish was listed as endangered on April 30, 1986 (51 FR 10850, March 31, 1986).

Description. The maximum length of the desert pupfish is approximately 3 inches (7.6 cm). The males are larger and develop a bright blue coloration on the dorsal portion of the head and sides and a yellow hue on the caudal fin and the posterior caudal peduncle during the breeding season. The females and juveniles have tan-to-olive backs and silvery sides. All adults have narrow dark bars on their sides (51 FR 10850, March 31, 1986).

Habits. The desert pupfish is a highly adaptable fish that can survive extreme environmental conditions, such as high water temperature, low oxygen levels, and high salinities. Spawning occurs in shallow water and lasts through the spring and summer. Newly hatched fish mature

very quickly, and three generations in a year are possible (51 FR 10850, March 31, 1986).

Habitat. Critical habitat has been designated at Quitobaquito Spring in the Organ Pipe Cactus National Monument, Pima County, Arizona, and at San Felipe Creek, Carrizo Wash, and Fish Creek Wash in the Salton Sea area of Imperial County, California. The species is also found in Salt Creek in Riverside County, California, and in a few shoreline pools and irrigation drains in Imperial and Riverside Counties, California; it may still exist in the Rio Sonoyta drainage and the Santa Clara Slough in Sonora, Mexico (51 FR 10850, March 31, 1986). Additional populations have been introduced in nine isolated waters in Santa Cruz, Cochise, Graham, La Paz, and Yavapai Counties, Arizona, and in nine locations in Riverside and San Diego Counties, California.

Factors in Species Decline. Since the 19th century, desert pupfish habitat has been steadily destroyed by streambank erosion, the construction of water impoundments that dewatered downstream habitat, excessive groundwater pumping, the application of pesticides to nearby agricultural areas, and the introduction of exotic fish species. The remaining populations continue to face these threats, and the Salton Sea area populations, in particular, are severely threatened (51 FR 10850, March 31, 1986).

Recovery Plan. None.

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, azinphos-methyl and malathion present an unacceptable risk to the desert pupfish in streams receiving insecticide-contaminated runoff from the cotton fields over the entire watershed. Also, both malathion and azinphos-methyl present an unacceptable risk to the desert pupfish in rivers receiving direct drift deposition and runoff concentrations from treated areas immediately upgradient from pupfish habitat. Any of the four insecticides may cause a temporary reduction in the species' food supply. The possible risk from malathion could be reduced to acceptable levels if no more than 1,400 acres (54 percent of the total cotton acres in the watershed) of cotton are treated at any one time. In addition, malathion should not be used within 125 feet (38 meters) upgradient of the desert pupfish's known habitat. Azinphos-methyl should not be used in any watershed containing known desert pupfish habitat. Drift buffers of 200 feet (60 meters) for aerial applications and 50 feet (15 meters) for ground applications should be instituted for fields abutting rivers and streams containing desert pupfish habitat. Best crop management practices should be strongly encouraged to decrease runoff from adjacent fields. The use of diflubenzuron and methyl parathion is unlikely to directly affect the species during program operations. To protect the species from accidental direct spray, aircraft overflights of the species' known

habitat in Cochise, Graham, La Paz, Pima, Santa Cruz, and Yavaipai Counties, Arizona, and Riverside and Imperial Counties, California, will be avoided.

Conclusion. May affect.

No Effect

Etheostoma fonticola—Fountain darter

Status. The fountain darter was listed as endangered on October 13, 1970 (35 FR 16047, October 13, 1970).

Description. The fountain darter achieves a maximum length of 1.5 inches (3.8 cm), and its scaled, reddish-brown sides are broadly margined with dusky pigment. The dorsal region is marked with fine specks and about eight indistinct cross-blotches. Three dark spots also are visible on the base of the tail, and a dark spot is noticeable on the opercle (FWS, 1984b). During the spawning period, the males develop black, red, and clear bands on the dorsal fin (Ono et al., 1983).

Habits. Aquatic insect larvae and small crustaceans found among bottom-growing vegetation and filamentous algae are the darter's primary food sources (Ono et al., 1983).

Habitat. Clear, cool spring waters with plentiful growths of aquatic vegetation are the preferred habitat of the fountain darter. Critical habitat for the fish includes Spring Lake and a short section of its outflow, the San Marcos River, in Hays County, Texas (45 FR 47355, July 14, 1980). Beyond the critical habitat area, a population is known to exist in the upper Comal River in Comal County, Texas (FWS, 1984b). According to the FWS' "Counties of Occurrence" list, the species may also exist in Caldwell County, Texas.

Factors in Species Decline. The decline of the fountain darter has paralleled the destruction of suitable habitat and the wide-scale pumping of the Edwards Aquifer, which recharges Spring Lake and the San Marcos River. Water impoundments have also contributed to the decline, eliminating the fountain darter from lower sections of the San Marcos. The threat of aquifer contamination will probably increase as development continues over the Edwards Aquifer recharge zones (45 FR 47355, July 14, 1980).

Recovery Plan. The goals of the Fountain Darter Recovery Plan are to preserve the species in its natural ecosystem and to undertake a comprehensive study to determine the steps necessary to remove the species from threatened status. The plan includes maintaining and enhancing populations in their current habitat, conserving habitat along the San Marcos River, establishing guidelines for recreational use on the San Marcos, studying individual and population needs and habitat

requirements, and establishing public information and education programs (FWS, 1984b).

Analysis of Program Impacts. The fountain darter's remaining habitat in Hays County, Texas, as well as the recharge areas for the San Marcos River and the Edwards Aquifer, is abutted by substantial residential and urban development. Cotton is not grown in this area.

Conclusion. No effect.

Clams

May Affect

Alasmidonta heterodon—Dwarf wedge mussel

Status. The dwarf wedge mussel was listed as an endangered species on April 13, 1990 (55 FR 9451, March 14, 1990).

Description. The dwarf wedge mussel is the only North American freshwater mussel that consistently possesses two lateral teeth on the right valve but only one on the left valve (Fuller, 1977; as cited in 55 FR 9451, March 14, 1990). A small mussel, the shell of *A. heterodon* is rarely longer than 1.5 inches (38 mm). The species exhibits strong sexual dimorphism; in females, posterior inflation of the shell accommodates the marsupial gills (55 FR 9451, March 14, 1990).

Habits. The species lives on muddy sand, sand, and gravel bottom substrates in creeks and rivers of varying sizes with slow to moderate currents and little silt deposition. Gravid (egg-laden) females are found from late August to June (Clarke, 1981; as cited in 55 FR 9451, March 14, 1990), and newly hatched larvae attach to a host fish. Although *A. heterodon*'s host species has not been determined, evidence suggests that the host fish is an anadromous or catadromous species (Master, 1986; as cited in 55 FR 9451, March 14, 1990).

Habitat. *A. heterodon* was once found in approximately 70 locations in 15 major Atlantic slope drainages ranging from New Brunswick, Canada, to the Neuse River system in North Carolina. Populations are still found in the Ashuelot River, Cheshire County, New Hampshire; in two reaches of the Connecticut River, Sullivan County, New Hampshire, and Windsor County, Vermont; in McIntosh Run, St. Mary's County, Maryland; in two tributaries of Tuckahoe Creek, Talbot, Queen Anne's, and Caroline Counties, Maryland; in the Little River, Johnston County, North Carolina; in the Tar River, Granville County, North Carolina; and in two Tar River tributaries, Franklin County, North Carolina (55 FR 9451, March 14, 1990). The FWS' "Counties of Occurrence" list also includes Wake County, North Carolina.

Factors in Species Decline. Many factors have contributed to the decline of the dwarf wedge mussel. Channelling and damming rivers has eliminated much of the species' original habitat by destroying preferred river-bottom substrates and natural water currents. Some

water impoundments have restricted the movement of anadromous fish through the mussel's habitat, which may have reduced or eliminated the hosts needed by larval *A. heterodon*. Land clearing and road construction have increased erosion and siltation, which may bury mussel populations and habitat areas. Agricultural, domestic, and industrial pollution also have been implicated in the species' decline. For example, no dwarf wedge mussels survive in several large, undammed sections of the Connecticut and Delaware River drainages where water pollution has severely limited the benthic fauna (Masters, 1986; as cited in 55 FR 9451, March 14, 1990). The loss of genetic variability, caused by the geographic isolation of mussel populations and small population densities, is another threat to the species' long-term survival (55 FR 9451, March 14, 1990).

Recovery Plan. None.

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, none of the control program insecticides presents an unacceptable risk to the dwarf wedge mussel in rivers receiving runoff from an entire watershed area. Also, none of the insecticides presents an unacceptable risk to the species in rivers receiving direct drift deposition and runoff concentrations from treated areas immediately upgradient from the mussel's habitat. Although unlikely, an emergency jettison of pesticide over dwarf wedge mussel habitat would present an unacceptable risk to this species. Aircraft overflights of the dwarf wedge mussel habitat in Johnston, Granville, Franklin, and Wake Counties, North Carolina, will be avoided.

Conclusion. May affect.

No Effect

Dromus dromas—Dromedary pearly mussel

Status. The dromedary pearly mussel was listed as endangered on July 14, 1976 (41 FR 24064, June 14, 1976).

Description. The dromedary pearly mussel is a medium-size freshwater mussel (greater than 3.9 inches (100 mm) long). The shell is typically rounded or sub-elliptical and yellow-green with broken green rays. The nacre of the shell in the big-river form is white to pinkish in color; the nacre of the headwater form is whitish pink, salmon, or reddish.

Habits. The dromedary pearly mussel is typically found in shallow, fast-flowing water with clean, stable substrates. However, it has also been found in approximately 18 feet (5.5 meters) of fast-flowing water. This mussel is a bradytictic species (that is, glochidia, or larvae, are retained over the winter in the gills of the female and released the following spring). Specific fish hosts are unknown.

Habitat. This species is considered extremely rare in the Tennessee, Clinch, Powell, and Cumberland Rivers. It is assumed that only a small part of the Tennessee River (Rhea and Meigs Counties, Tennessee) and the Cumberland River (Trousdale and Smith Counties, Tennessee) contain the big-river form of the species, and that the headwater variety is limited to the Clinch and Powell Rivers above the Norris Reservoir (Hancock and Clairborne Counties, Tennessee, and Lee County, Virginia). The FWS' "Counties of Occurrence" list includes Giles County, Tennessee.

Factors in Species Decline. The reason for the decline of this species is not entirely understood, although impoundments, siltation, and pollution may be principal causes.

Recovery Plan. The ultimate objective of the Dromedary Pearly Mussel Recovery Plan is to restore this species to a significant portion of its historical range and to remove it from the Federal list of threatened and endangered species. This species shall be considered recovered when the following criteria are met:

1. A viable population exists in the Clinch and Powell Rivers above the Norris Reservoir.

2. Viable populations exist in three additional rivers.

3. The species and its habitat are protected from present and foreseeable human-related or natural threats.

4. Coal-related problems are noticeably reduced in the Powell, Clinch, and Cumberland Rivers (FWS, 1983b).

Analysis of Program Impacts. The boll weevil control program will not affect the dromedary pearly mussel because the mussel's current habitat is located upstream from cotton-producing counties.

Conclusion. No effect.

Crustaceans

May Affect

***Palaemonias alabamae*—Alabama cave shrimp**

Status. The Alabama cave shrimp was listed as endangered on October 7, 1988 (53 FR 34698, September 7, 1988).

Description. This species is colorless and transparent, like other albinistic cave shrimp. It is 0.8 inches (20 mm) long. The other species in this genera, the Kentucky cave shrimp (*Palaemonias ganteri*), is also endangered.

Habits. This species is a troglodyte (lives only in caves). Its diet and reproductive behavior are unknown.

Habitat. This species is known only in Shelta and Bobcat Caves, Madison County, Alabama, and may have been extirpated from Shelta Cave. Other species found in this habitat are southern cavefish (*Typhlichthys subterraneous*), cave salamander (*Gyrinophilus palleucus*), and the cave crayfish (*Avticambarus jonesi*). Shelta Cave is owned by the National Speleological Society and is gated to prevent unauthorized visitors; Bobcat Cave is owned by Redstone Arsenal, under control of the U.S. Army. The FWS' "Counties of Occurrence" list includes Madison County, Alabama.

Factors in Species Decline. The biggest threat to the Alabama cave shrimp may be groundwater contamination, possibly by DDT. The shrimp's survival is also affected by its apparently low reproductive capabilities, confined habitat, and inability to elude captors (53 FR 34698, September 7, 1988).

Recovery Plan. None.

Analysis of Program Impacts. Because azinphos-methyl will not be used anywhere in Alabama, its potential effect on the Alabama cave shrimp was not analyzed in this biological assessment. The GLEAMS model was unable to predict the potential insecticide concentrations for the other control program chemicals in the Alabama cave shrimp's habitat because it lives in a protected cave that is fed by an undetermined level of groundwater flow. However, the results of the aquatic species risk assessment for other endangered and threatened species suggest that malathion would probably present an unacceptable risk to the species. The Alabama cave shrimp is unlikely to experience direct toxic effects because the species' cave habitat should adequately protect it from insecticide exposure. Although all insecticides have the potential to affect aquatic invertebrate populations, which may be the Alabama cave shrimp's food source, the natural protection afforded by caves should reduce that risk. Also, groundwater contamination is unlikely because none of the control program insecticides has demonstrated significant leaching potential. To eliminate any possible risks from groundwater contamination, standard operating procedures for the boll weevil program incorporate adequate safeguards for mixing, loading, and storing insecticides. The procedures also guide program personnel in the proper handling of emergency spills and disposal of insecticide containers. The use of these procedures will ensure that there is no effect on the Alabama cave shrimp or its habitat. Diflubenzuron and methyl parathion are unlikely to affect the species during program activities. To eliminate the risk of an accidental direct spray, aircraft overflights of Shelta and Bobcat Caves and their recharge areas in Madison County, Alabama, will be avoided.

Conclusion. May affect.

May Affect

***Tumamoca macdougalii*—Tumamoc globe-berry**

Status. The Tumamoc globe-berry was listed as endangered on May 29, 1986 (51 FR 15911, April 29, 1986).

Description. The Tumamoc globe-berry is a delicate perennial vine in the gourd family (*Cucurbitaceae*). The species has a tuberous root and slender, herbaceous stems. The thin leaves have three main lobes, which are divided into narrow segments. The small yellow male and female flowers produce small, red, watermelon-like fruit.

Habits. Flowering starts before the summer rains begin. This species uses nurse plants for shade, protection, and support for its vines. Details about the population ecology of this species are poorly understood, but insects may be important seed dispersal agents.

Habitat. The Tumamoc globe-berry is found in the desert scrub region. The species often grows in rocky to gravelly sandy silt and clay, in granite, basalt, or rhyolite regions. Typical plant species in this community include the creosote bush (*Larrea tridentata*), paloverde (*Cercidium* spp.), white thorn acacia (*Acacia constricta*), saguaro cactus (*Carnegiea gigantea*), prickly pear (*Opuntia phaeacantha*), cane cholla (*Opuntia versicolor*), mesquite (*Prosopis juliflora*), ironwood (*Olneya tesota*), and triangle leaf bursage (*Ambrosia deltoidea*). Nurse plants for the Tumamoc globe-berry include the creosote bush, triangle leaf bursage, white thorn acacia, all scale, pencil cholla, and palo-verde. There are more than 30 populations in Pima County, Arizona, and an additional five populations are known from Northern Sonora, Mexico. The FWS' "Counties of Occurrence" list includes Pima and Pinal Counties, Arizona.

Factors in Species Decline. The species has declined because of habitat destruction. Factors in the destruction include development, aqueduct construction, grazing, and collecting.

Recovery Plan. None.

Analysis of Program Impacts. Although the Tumamoc globe-berry's population dynamics are not clearly understood, the species may be dependent on insect pollinators for reproduction. Consequently, populations located immediately adjacent to cotton fields may be indirectly affected by a short-term reduction in insect pollinators. To protect the species from a depletion of insects that may be involved in pollination, the control program insecticides should not be applied within 300 feet (91.4 m) of known Tumamoc globe-berry habitat during pollination time.

Conclusion. May affect.

No Effect

Coryphantha sneedii var. *sneedii*—Sneed pincushion cactus

Status. The Sneed pincushion cactus was listed as endangered on December 7, 1979 (44 FR 64743, November 7, 1979).

Description. This many-branched cactus forms tight clumps of 100 or more stems. Stems are cylindroid to club-shaped and are 1 to 3 inches (2.5 to 7.5 cm) long and 0.4 to 1 inches (1 to 3 cm) in diameter. The central spines (6 to 17 per aerole) are white and brown with pink tips. The radial spines (35 to 90 per aerole) are white and 0.10 to 0.5 inches (5 to 12 mm) long. Flowers are 0.5 inches (1.2 cm) tall, pale rose to brownish pink, and contain pink filaments and orange anthers.

Habits. Flowers bloom in April and last about 2 to 4 days. The blooms open about midday. Fruit forms from August to November. The fruit does not dehisce, and rodents and birds are believed to be the primary seed dispersal agents. The cactus also reproduces vegetatively, and seedlings are present at all locations.

Habitat. The Sneed pincushion cactus is found in semidesert grassland. Characteristic plants are *Agave lecheguilla, Ephedra trifurca, Juniperus pinchotii, Krameria grayi,* and *Quercus* spp. This species grows in vertical cracks and ledges in limestone and has been found in the Franklin Mountains in El Paso County, Texas; Dona Ana County, New Mexico; the Organ Mountains in New Mexico, and the Guadalupe Mountains of Texas and New Mexico. Of the 20 localities, 7 are on private lands, and 13 are on Federal lands (BLM lands, Fort Bliss Military Reservation, Lincoln National Forest, Guadalupe Mountains National Park, and Carlsbad Caverns National Park). The FWS' "Counties of Occurrence" list shows this plant to exist only in Dona Ana County, New Mexico.

Factors in Species Decline. The main cause for the decline of this species is overcollection by commercial and private collectors. There has also been some habitat destruction on private lands. Potential threats include trail and other recreational development in Guadalupe Mountains and Carlsbad Caverns National Parks.

Recovery Plan. The primary objective of the Sneed and Lee Pincushion Cacti Recovery Plan is to downlist and delist the Sneed pincushion cactus from the Federal endangered, threatened, and proposed species list. This can be accomplished by removing the threats of collecting by enforcing current State and Federal laws, managing existing habitat, and studying population biology and ecology (FWS, 1986).

Analysis of Program Impacts. The Sneed pincushion cactus occurs in rugged, mountainous areas that do not support cotton production. For

this reason, the control program will have no direct or indirect effects on the species.

Conclusion. No effect.

Insects

No Effect

***Texamaurops reddelli*—Kretschmarr Cave mold beetle**

Status. The Kretschmarr Cave mold beetle was listed as endangered on September 16, 1988 (53 FR 36033, September 16, 1988).

Description. The Kretschmarr Cave mold beetle is in the family Pselaphidae. It is very small, 0.1 inches (3 mm) long, eyeless, dark colored, and has short wings and elongated legs.

Habits. This species is a troglodyte (lives only in caves).

Habitat. This species is found only in Amber, Tooth, Coffin, and Kretschmarr Caves, in Travis and Williamson Counties, Texas. These small, shallow, dry caves are isolated islands in the Edwards Limestone formation that were separated when stream channels cut through the limestone to lower rock layers. This habitat fragmentation has resulted in the isolated groups of caves that have developed their own fauna.

Factors in Species Decline. Urban, industrial, and highway expansion could cause them to collapse, disturb drainage patterns, and increase the flow of sediment and general urban runoff into these caves (53 FR 36033, September 16, 1988).

Recovery Plan. None.

Analysis of Program Impacts. The Kretschmarr Cave mold beetle's cave habitat occurs in the cotton-producing counties of Travis and Williamson Counties in Texas. However, these dry caves are unlikely to be affected by insecticide runoff, drift, or direct spray. In addition, the caves are located near the outskirts of Austin, Texas, an area experiencing steady urban expansion; thus, cotton production is unlikely to occur on the lands adjacent to or over the beetle's cave habitat.

Conclusion. No effect.

Section 5

Conclusion

The 1990 biological assessment for the National Boll Weevil Cooperative Control Program analyzed the program's potential effects on 198 endangered, threatened, and proposed species. The assessment determined that the program will have no effect on 113 species but may affect 85 species. For these "may affect" species, protection measures, including the maintenance of buffers and the reduction of insecticide applications in watersheds containing sensitive aquatic species, were devised to preclude any direct or indirect risk from insecticide exposure.

However, completion of the biological assessment marks only the beginning of the Animal and Plant Inspection Service's (APHIS') analysis of potential risk to endangered, threatened, and proposed species in the Cotton Belt. The biological assessment initiated formal consultation between APHIS and the U.S. Fish and Wildlife Service (FWS) and will serve as a model for subsequent endangered and threatened species analyses. During the scheduled 20-year lifespan of the project, additional wildlife and aquatic species in the Cotton Belt will undoubtedly require Endangered Species Act (ESA) protection, while the regulatory status of currently listed species may change. Also, shifts in the location of cotton production will probably occur during the program, thereby increasing the risk of insecticide exposure for some species while reducing the risk for others. Thus, APHIS and FWS will periodically update the "Counties of Occurrence" list to include new species, to compensate for shifting trends in the geographical distribution of cotton production, and to accurately reflect any new habitat or range information for previously listed species.

As the control program moves into other parts of the Cotton Belt during the next decade, APHIS will prepare site-specific environmental assessments as needed that discuss the program's potential effects on a much more detailed, regional scale than the EIS. Using updated "Counties of Occurrence" lists, APHIS will complete an endangered, threatened, and proposed species risk assessment, including a complete decision-tree analysis, for all endangered, threatened, or proposed species within the scope of a given site-specific assessment, including any newly listed species and all species analyzed in the original biological assessment. APHIS will then use the biological assessment, the related FWS biological opinion (FWS' critical analysis of the biological assessment), and the site-specific environmental assessments to plan and implement adequate safeguards to protect all endangered, threatened, and proposed species that occur in or may be affected by cotton-producing areas of the United States.

Attachment A

Federally Listed Endangered, Threatened, and Proposed Species in Cotton-Producing Counties of Control Program States and Their Regulatory Status

Table A-1 lists the federally listed endangered, threatened, and proposed species found in the cotton-producing counties of States in which the National Boll Weevil Cooperative Control Program will be conducted. Candidate species are not included in the list.

The abbreviations and footnotes used in the table are defined as follows:

E = Endangered species—any species in danger of extinction throughout all or a significant portion of its range.

T = Threatened species—any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

P = Proposed species—any species that has been proposed for listing as an endangered or threatened species.

EC & TC = Endangered (E) or threatened (T) species for which a critical habitat has been designated. The term "critical habitat" refers to the specific areas within the species' geographical range or biological features essential to the conservation of that species; these areas or features may require special management considerations or protection. Critical habitat also includes specific areas outside the species' geographical range that are essential for its conservation.

Table A-1. Federally Listed Endangered, Threatened, and Proposed Species in Cotton-Producing Counties of Control Program States and Their Regulatory Status

		States																
Common name	Scientific name	AL	FL	GA	NC	SC	VA	AR	LA	MO	MS	TN	KS	OK	TX	AZ	CA	NM
Mammals:																		
Bat, gray	*Myotis grisescens*	E	E	E	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Bat, Indiana	*Myotis sodalis*	E	E	E	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Bat, Sanborn's long-nosed	*Leptonycteris sanborni (=yerbabuenae)*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Cougar, eastern	*Felis concolor couguar*	—	—	E	—	E	—	—	—	—	—	—	—	—	—	—	—	—
Ferret, black-footed	*Mustela nigripes*	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—
Fox, San Joaquin kit	*Vulpes macrotis mutica*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—
Jaguarundi	*Felis yagouaroundi cacomitli*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Manatee, West Indian (Florida)	*Trichechus manatus*	—	—	EC	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mouse, Alabama beach	*Peromyscus polionotus ammobates*	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mouse, Perdido Key beach	*Peromyscus polionotus trissyllepsis*	E	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mouse, Choctawhatchee beach	*Peromyscus polionotus allophrys*	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ocelot	*Felis pardalis*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Panther, Florida	*Felis concolor coryi*	—	E	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pronghorn, Sonoran	*Antilocapra americana sonoriensis*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Rat, Fresno kangaroo	*Dipodomys nitratoides exilis*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	EC	—
Rat, giant kangaroo	*Dipodomys ingens*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—
Rat, Stephens' kangaroo	*Dipodomys stephensi*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—
Rat, Tipton kangaroo	*Dipodomys nitratoides nitratoides*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—
Shrew, Dismal Swamp southeastern	*Sorex longirostris fisheri*	—	—	—	T	—	—	—	—	—	—	—	—	—	—	—	—	—
Vole, Hualapai Mexican	*Microtus mexicanus hualpaiensis*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Birds:																		
Bobwhite, masked (quail)	*Colinus virginianus ridgwayi*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Condor, Andean	*Vultur gryphus*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—
Condor, California	*Gymnogyps californianus*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	EC	—
Crane, whooping	*Grus americana*	—	—	—	—	—	—	—	—	—	—	—	EC	—	EC	EC	—	EC
Eagle, bald	*Haliaeetus leucocephalus*	E	E	E	E	E	—	E	E	E	E	E	E	E	E	E	EC	E
Falcon, American peregrine	*Falco peregrinus anatum*	—	—	—	—	—	—	—	—	—	—	E	—	—	E	E	E	E
Falcon, Arctic peregrine[a]	*Falco peregrinus tundrius*	—	—	T	—	T	—	—	—	—	—	—	—	—	—	—	—	—
Falcon, northern aplomado	*Falco femoralis septentrionalis*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Falcon, peregrine[a]	*Falco peregrinus*	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—
Goose, Aleutian Canada	*Branta canadensis leucopareia*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—
Pelican, brown	*Pelecanus occidentalis*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	E	—
Pelican, California brown	*Pelecanus occidentalis californicus*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—
Plover, piping	*Charadrius melodus*	T	—	T	—	—	—	—	—	—	—	—	T	T	T	—	—	—

Table A-1. Federally Listed Endangered, Threatened, and Proposed Species in Cotton-Producing Counties of Control Program States and Their Regulatory Status (continued)

Common name	Scientific name	States																
		AL	FL	GA	NC	SC	VA	AR	LA	MO	MS	TN	KS	OK	TX	AZ	CA	NM
Birds (continued):																		
Prairie-chicken, Attwater's greater	*Tympanuchus cupido attwaterii*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Rail, Yuma clapper	*Rallus longirostris yumanensis*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	E	—
Sparrow, Cape Sable	*Ammodramus (=Ammospiza) maritimus mirabilis*	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Stork, wood	*Mycteria americana*	—	E	E	—	E	—	—	—	—	—	E	—	—	—	—	—	—
Tern, interior least	*Sterna antillarum*	—	—	—	—	—	—	E	—	E	—	E	E	E	E	—	—	E
Vireo, black-capped	*Vireo atricapillus*	—	—	—	—	—	—	—	—	—	—	—	E	E	E	—	—	—
Vireo, least Bell's	*Vireo bellii pusillus*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—
Warbler (wood), Bachman's	*Vermivora bachmanii*	—	E	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Warbler (wood), Kirtland's	*Dendroica kirtlandii*	E	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Woodpecker, red-cockaded	*Picoides (=Dendrocopus) borealis*	E	E	E	E	E	—	E	E	—	E	—	—	—	E	—	—	—
Reptiles:																		
Lizard, blunt-nosed leopard	*Gambelia (=Crotaphytus) silus*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—
Lizard, Coachella Valley fringe-toed	*Uma inornata*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	TC	—
Snake, Concho water	*Nerodia harteri paucimaculata*	—	—	—	—	—	—	—	—	—	—	—	—	—	TC	—	—	—
Snake, eastern indigo	*Drymarchon corais couperi*	T	T	T	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tortoise, desert (Mohave population)	*Gopherus agassizii*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	T	—	—
Tortoise, gopher	*Gopherus polyphemus*	T	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Turtle, Alabama red-bellied	*Pseudemys alabamensis*	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Turtle, flattened musk	*Sternotherus depressus*	T	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Turtle, Kemp's (=Atlantic) ridley sea	*Lepidochelys kempii*	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Turtle, loggerhead sea	*Caretta caretta*	—	—	T	—	T	—	—	—	—	—	—	—	—	—	—	—	—
Turtle, ringed sawback	*Graptemys oculifera*	—	—	—	—	—	—	—	—	—	T	—	—	—	—	—	—	—
Amphibians:																		
Salamander, Red Hills	*Phaeognathus hubrichti*	T	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Salamander, San Marcos	*Eurycea nana*	—	—	—	—	—	—	—	—	—	—	—	—	—	TC	—	—	—
Salamander, Texas blind	*Typhlomolge rathbuni*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Toad, Houston	*Bufo houstonensis*	—	—	—	—	—	—	—	—	—	—	—	—	—	EC	—	—	—
Fish:																		
Catfish, Yaqui	*Ictalurus pricei*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	T	—	—
Cavefish, Alabama	*Speoplatyrhinus poulsoni*	EC	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chub, bonytail	*Gila elegans*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—

Table A-1. Federally Listed Endangered, Threatened, and Proposed Species in Cotton-Producing Counties of Control Program States and Their Regulatory Status (continued)

Common name	Scientific name	States																
		AL	FL	GA	NC	SC	VA	AR	LA	MO	MS	TN	KS	OK	TX	AZ	CA	NM
Fish (continued):																		
Chub, Chihuahua	*Gila nigrescens*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	T
Chub, Sonora	*Gila ditaenia*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	T	—	—
Chub, spotfin	*Cyprinella (=Hybopsis) monacha*	—	—	—	—	—	—	—	—	—	—	TC	—	—	—	—	—	—
Chub, Virgin River	*Gila robusta seminuda*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Chub, Yaqui	*Gila purpurea*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Darter, amber	*Percina antesella*	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Darter, bayou	*Etheostoma rubrum*	—	—	—	—	—	—	—	—	—	T	—	—	—	—	—	—	—
Darter, boulder (=Elk River)	*Etheostoma wapiti*	E	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Darter, fountain	*Etheostoma fonticola*	—	—	—	—	—	—	—	—	—	—	—	—	—	EC	—	—	—
Darter, Okaloosa	*Etheostoma okaloosae*	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Darter, slackwater	*Etheostoma boschungi*	TC	—	—	—	—	—	—	—	—	—	TC	—	—	—	—	—	—
Darter, snail	*Percina tanasi*	T	—	—	—	—	—	—	—	—	—	T	—	—	—	—	—	—
Darter, watercress	*Etheostoma nuchale*	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gambusia, Pecos	*Gambusia nobilis*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	E
Gambusia, San Marcos	*Gambusia georgei*	—	—	—	—	—	—	—	—	—	—	—	—	—	EC	—	—	—
Logperch, Conasauga	*Percina jenkinsi*	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Logperch, Roanoke	*Percina rex*	—	—	—	—	—	—	E	—	—	—	—	—	—	—	—	—	—
Minnow, loach	*Tiaroga cobitis*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	T	—	—
Pupfish, Comanche Springs	*Cyprinodon elegans*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Pupfish, desert	*Cyprinodon macularius*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	EC	EC	—
Pupfish, Leon Springs	*Cyprinodon bovinus*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Sculpin, pygmy	*Cottus pygmaeus*	T	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Shiner, beautiful	*Cyprinella (=Notropis) formosa (=formosus)*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	TC	—
Shiner, Cahaba	*Notropis cahabae*	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Shiner, Cape Fear	*Notropis mekistocholas*	—	—	—	EC	—	—	—	—	—	—	—	—	—	—	—	—	—
Shiner, Pecos bluntnose	*Notropis simus pecosensis*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	TC
Spikedace	*Meda fulgida*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	T	—	—
Sturgeon, Gulf	*Acipenser oxyrhynchus desotoi*	T	T	—	—	—	—	—	T	—	T	—	—	—	—	—	—	—
Sturgeon, shortnose	*Acipenser brevirostrum*	—	—	—	E	E	—	—	—	—	—	—	—	—	—	—	—	—
Sucker, razorback	*Xyrauchen texanus*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	PE	—	—
Topminnow, Gila	*Poeciliopsis occidentalis*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Topminnow, Yaqui	*Poeciliopsis occidentalis sonoriensis*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Woundfin	*Plagopterus argentissimus*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Snails:																		
Snail, painted snake coiled forest	*Anguispira picta*	—	—	—	—	—	—	—	—	—	—	T	—	—	—	—	—	—
Snail, tulotoma	*Tulotoma magnifica*	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1. Federally Listed Endangered, Threatened, and Proposed Species in Cotton-Producing Counties of Control Program States and Their Regulatory Status (continued)

Common name	Scientific name	AL	FL	GA	NC	SC	VA	AR	LA	MO	MS	TN	KS	OK	TX	AZ	CA	NM
		States																
Clams:																		
Mussel, Curtus'	*Pleurobema curtum*	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—	—
Mussel, dwarf wedge	*Alasmidonta heterodon*	—	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—
Mussel, fanshell	*Cyprogenia stegaria (=C. Irrorata)*	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Mussel, inflated heelsplitter	*Potamilus inflatus*	PT	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mussel, Judge Tait's	*Pleurobema taitianum*	E	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—	—
Mussel, Marshall's	*Pleurobema marshalli*	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mussel, penitent	*Epioblasma (=Dysnomia) penita*	E	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—	—
Mussel, ring pink	*Obovaria retusa*	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pearlshell, Louisiana	*Margaritifera hembeli*	—	—	—	—	—	—	—	E	—	—	—	—	—	—	—	—	—
Pearly mussel, Alabama lamp	*Lampsilis virescens*	E	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pearly mussel, birdwing	*Conradilla caelata*	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pearly mussel, cracking	*Hemistena (=Lastena) lata*	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pearly mussel, Cumberland monkeyface	*Quadrula intermedia*	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pearly mussel, Curtis'	*Epioblasma (=Dysnomia) florentina curtisi*	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—	—	—
Pearly mussel, dromedary	*Dromus dromas*	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pearly mussel (=pimple back), orange-footed	*Plethobasus cooperianus*	E	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pearly mussel, pale lilliput	*Toxolasma (=Carunculina) cylindrellus*	E	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pearly mussel, pink mucket	*Lampsilis orbiculata*	E	—	—	—	—	—	E	—	E	—	E	—	—	—	—	—	—
Pearly mussel, tubercled-blossom	*Epioblasma (=Dysnomia) torulosa torulosa*	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pearly mussel, white wartyback	*Plethobasus cicatricosus*	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pearly mussel, yellow-blossom	*Epioblasma (=Dysnomia) florentina florentina*	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pigtoe, fine-rayed	*Fusconia cuneolus*	E	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pigtoe, rough	*Pleurobema plenum*	E	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pigtoe, shiny	*Fusconaia edgariana*	E	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Pocketbook, fat	*Potamilus (=Proptera) capax*	—	—	—	—	—	—	E	—	E	—	—	—	—	—	—	—	—
Riffle shell, tan	*Epioblasma walkeri*	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Spinymussel, Tar River	*Elliptio (=Canthyria) steinstansana*	—	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—
Stirrup shell	*Quadrula stapes*	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1. Federally Listed Endangered, Threatened, and Proposed Species in Cotton-Producing Counties of Control Program States and Their Regulatory Status (continued)

Common name	Scientific name	AL	FL	GA	NC	SC	VA	AR	LA	MO	MS	TN	KS	OK	TX	AZ	CA	NM
		States																
Crustaceans:																		
Shrimp, Alabama cave	*Palaemonias alabamae*	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Insects:																		
Beetle, Kretschmarr Cave mold	*Texamaurops reddelli*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Beetle, Tooth Cave ground	*Rhadine persephone*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Beetle, valley elderberry longhorn	*Desmocerus californicus dimorphus*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	TC	—
Moth, Kern primrose sphinx	*Euproserpinus euterpe*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	T	—
Arachnids:																		
Harvestman, Bee Creek Cave	*Texella reddelli*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Pseudoscorpion, Tooth Cave	*Microcreagris texana*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Spider, Tooth Cave	*Leptoneta myopica*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Plants:																		
Agave, Arizona	*Agave arizonica*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Amphianthus, little	*Amphianthus pusillus*	T	—	T	—	T	—	—	—	—	—	—	—	—	—	—	—	—
Arrowhead, bunched	*Sagittaria fasciculata*	—	—	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—
Beauty, Harper's	*Harperocallis flava*	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bird's-beak, palmate-bracted	*Cordylanthus palmatus*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—
Bladderpod, lyrate	*Lesquerella lyrata*	T	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Blue-star, Kearney's	*Amsonia kearneyana*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Buttons, Mohr's Barbara's	*Marshallia mohrii*	T	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cactus, Bakersfield	*Opuntia treleasi*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	PE	—
Cactus, black lace	*Echinocereus reichenbachii* var. *albertii (=E. melanocentrus)*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Cactus, Cochise pincushion	*Coryphantha robbinsorum*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	T	—	—
Cactus, Kuenzler hedgehog	*Echinocereus fendleri* var. *kuenzleri (=E. kuenzleri, E. hempelii)*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E
Cactus, Lee pincushion	*Coryphantha sneedii* var. *leei (=Escobaria l., Mammillaria l.)*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	T
Cactus, Lloyd's hedgehog	*Echinocereus lloydii (=E. roetteri* var. *l.)*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E
Cactus, Nichol's Turk's head	*Echinocactus horizonthalonius* var. *nicholii*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Cactus, Siler pincushion	*Pediocactus silen (=Echinocactus s., Utahia S.)*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—

Table A-1. Federally Listed Endangered, Threatened, and Proposed Species in Cotton-Producing Counties of Control Program States and Their Regulatory Status (continued)

Common name	Scientific name	AL	FL	GA	NC	SC	VA	AR	LA	MO	MS	TN	KS	OK	TX	AZ	CA	NM
		States																
Plants (continued):																		
Cactus, Sneed pincushion	*Coryphantha sneedii* var. *sneedii* (=*Escobaria s., Mammillaria s.*)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E
Campion, fringed	*Silene polypetala*	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cliffrose, Arizona	*Purchia subintegra* (=*Cowania s.*)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Coneflower, Tennessee purple	*Echinacea tennesseensis*	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Dogweed, ashy	*Thymophylla tephroleuca* (*Dyssodia tephroleuca*)	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Dropwort, Canby's	*Oxypolis canbyi*	—	—	E	E	E	—	—	—	—	E	—	—	—	—	—	—	—
Fern, American hart's-tongue	*Phyllitis scolopendrium* var. *americana* (=*P. japonica* ssp. *a.*)	T	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Frankenia, Johnston's	*Frankenia johnstonii*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Geocarpon minimum	*Geocarpon minimum*	—	—	—	—	—	—	T	—	—	—	—	—	—	—	—	—	—
Globe-berry, Tumamoc	*Tumamoca macdougalii*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—
Gooseberry, Miccosukee	*Ribes echinellum*	—	—	—	—	T	—	—	—	—	—	—	—	—	—	—	—	—
Grass, Tennessee yellow-eyed	*Xyris tennesseensis*	E	—	E	—	—	—	—	—	—	—	E	—	—	—	—	—	—
Harperella	*Ptilimnium nodosum*	E	—	E	E	E	—	—	—	—	—	—	—	—	—	—	—	—
Heartleaf, dwarf-flowered	*Hexastylis naniflora*	—	—	—	—	T	—	—	—	—	—	—	—	—	—	—	—	—
Jewelflower, California	*Caulanthus californicus*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	PE	—
Leather flower, Alabama	*Clematis socialis*	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Loosestrife, rough-leaved	*Lysimachia asperulaefolia*	—	—	—	E	E	—	—	—	—	—	—	—	—	—	—	—	—
Mallow, Kern	*Eremalche kernensis*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	PE	—
Meadowrue, Cooley's	*Thalictrum cooleyi*	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pennyroyal, McKittrick	*Hedeoma apiculatum*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	TC
Pennyroyal, Todsen's	*Hedeoma todsenii*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	EC
Pink, swamp	*Helonias bullata*	—	—	—	—	T	—	—	—	—	—	—	—	—	—	—	—	—
Pinkroot, gentian	*Spigelia gentianoides*	—	PE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pitcher-plant, Alabama canebrake	*Sarracenia rubra* ssp. *alabamensis* (=*S. alabamensis* ssp. *a.*)	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pitcher-plant, green	*Sarracenia oreophila*	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pitcher-plant, mountain sweet	*Sarracenia rubra* ssp. *jonesii* (=*S. jonesii*)	—	—	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—
Pogonia, small whorled	*Isotria medeoloides*	—	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—
Pondberry	*Lindera melissifolia*	—	—	E	E	E	—	E	—	—	E	—	—	—	—	—	—	—
Potato-bean, Price's	*Apios priceana*	T	—	—	—	—	—	—	—	—	T	—	—	—	—	—	—	—
Prairie-clover, leafy	*Dalea foliosa*	PE	—	—	—	—	—	—	—	—	—	PE	—	—	—	—	—	—
Prickly-poppy, Sacramento	*Argemone pleiacantha* ssp. *pinnatisecta*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E
Quillwort, black-spored	*Isoetes melanospora*	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1. Federally Listed Endangered, Threatened, and Proposed Species in Cotton-Producing Counties of Control Program States and Their Regulatory Status (continued)

Common name	Scientific name	States																
		AL	FL	GA	NC	SC	VA	AR	LA	MO	MS	TN	KS	OK	TX	AZ	CA	NM
Plants (continued):																		
Quillwort, mat-forming	*Isoetes tegetiformans*	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rattleweed, hairy	*Baptisia arachnifera*	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rhododendron, Chapman	*Rhododendron chapmanii*	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rush-pea, slender	*Hoffmannseggia tenella*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Sand-verbena, large-fruited	*Abronia macrocarpa*	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Skullcap, large-flowered	*Scutellaria montana*	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Spirea, Virginia	*Spirea virginiana*	—	—	T	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sumac, Michaux's	*Rhus michauxii*	—	—	E	E	—	—	—	—	—	—	—	—	—	—	—	—	—
Sunflower, Schweinitz's	*Helianthus schweinitzii*	—	—	—	PE	PE	—	—	—	—	—	—	—	—	—	—	—	—
Thistle, Sacramento Mountains	*Cirsium vinaceum*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	T
Torreya, Florida	*Torreya taxifolia*	—	E	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Trillium, persistent	*Trillium persistens*	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Trillium, relict	*Trillium reliquum*	E	—	E	—	E	—	—	—	—	—	—	—	—	—	—	—	—
Water-plantain, Kral's	*Sagittaria secundifolia*	T	—	T	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Wild-buckwheat, gypsum	*Eriogonum gypsophilum*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	TC
Wild-rice, Texas	*Zizania texana*	—	—	—	—	—	—	—	—	—	—	—	—	—	EC	—	—	—
Wooly-star, Hoover's	*Eriastrum hooveri*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	PT	—
Wooly-threads, San Joaquin	*Lembertia congdonii*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—

[a] Similarity of appearance.

Attachment B

General Habitat Locations of the Federally Listed Endangered, Threatened, and Proposed Species in the 17 Cotton Belt States

Figures B-1 through B-4 list the general habitat locations of the federally listed endangered, threatened, and proposed species found in the 17 Cotton Belt States in which the National Boll Weevil Cooperative Control Program will be conducted.

To indicate the species' habitat locations on the maps, each of the 198 species was assigned a number. The number was then enclosed by either a circle or a rectangle to provide additional information about the species' distribution in a particular State. These symbols are defined as follows:

1 = General habitat—the species occurs in the county designated by the number (county boundaries are not shown) but also occurs in one or more other counties in the State.

$\boxed{2}$ = Specific county habitat—the species is known to occur in only one county in the State, as designated by the number (county boundaries are not shown).

A key to the species habitat location maps follows the figures.

Figure B-1. Endangered and Threatened Species Habitat Locations in the Southeast-Coastal Region

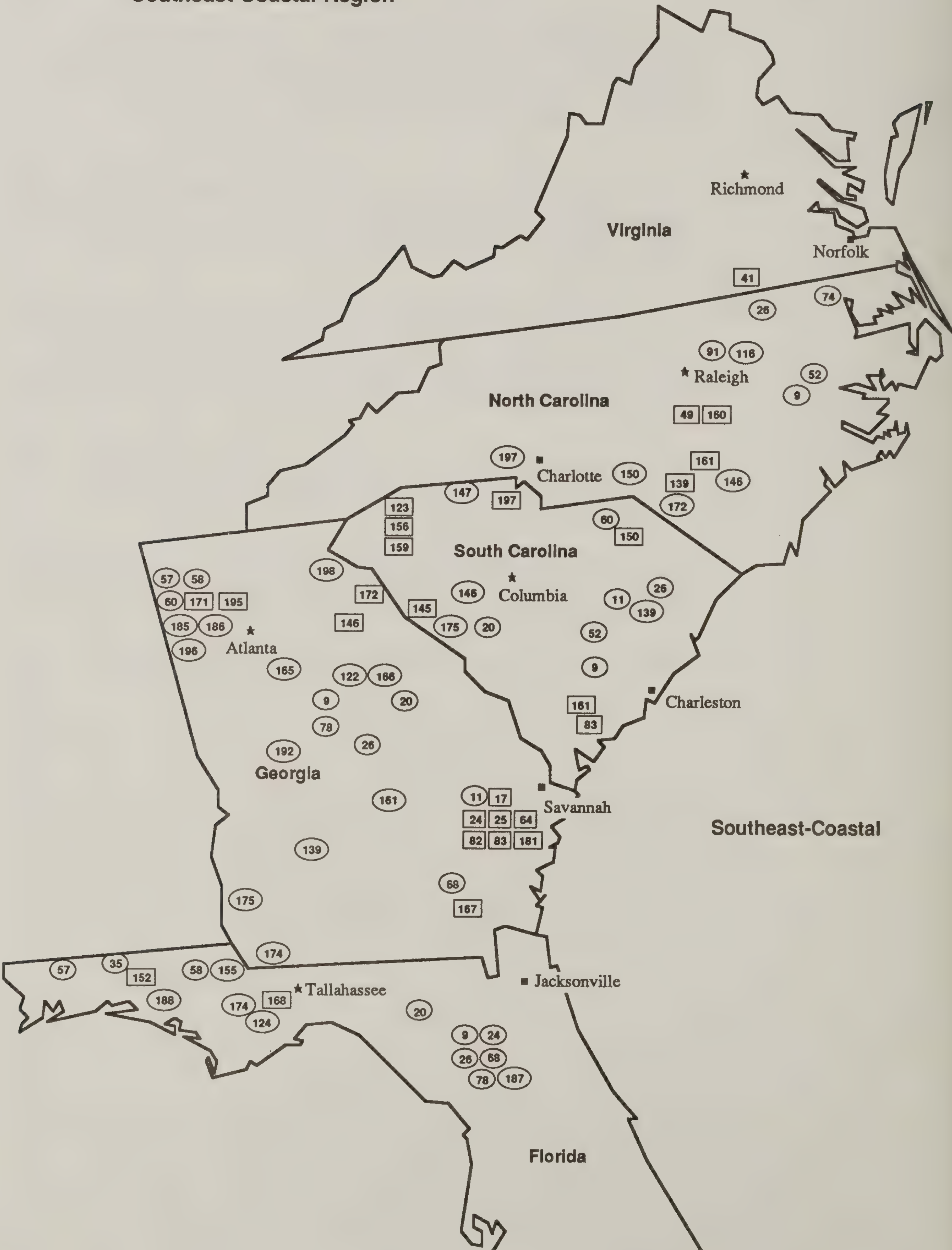


Figure B-2. Endangered and Threatened Species Habitat Locations in the Southeast-Delta Region

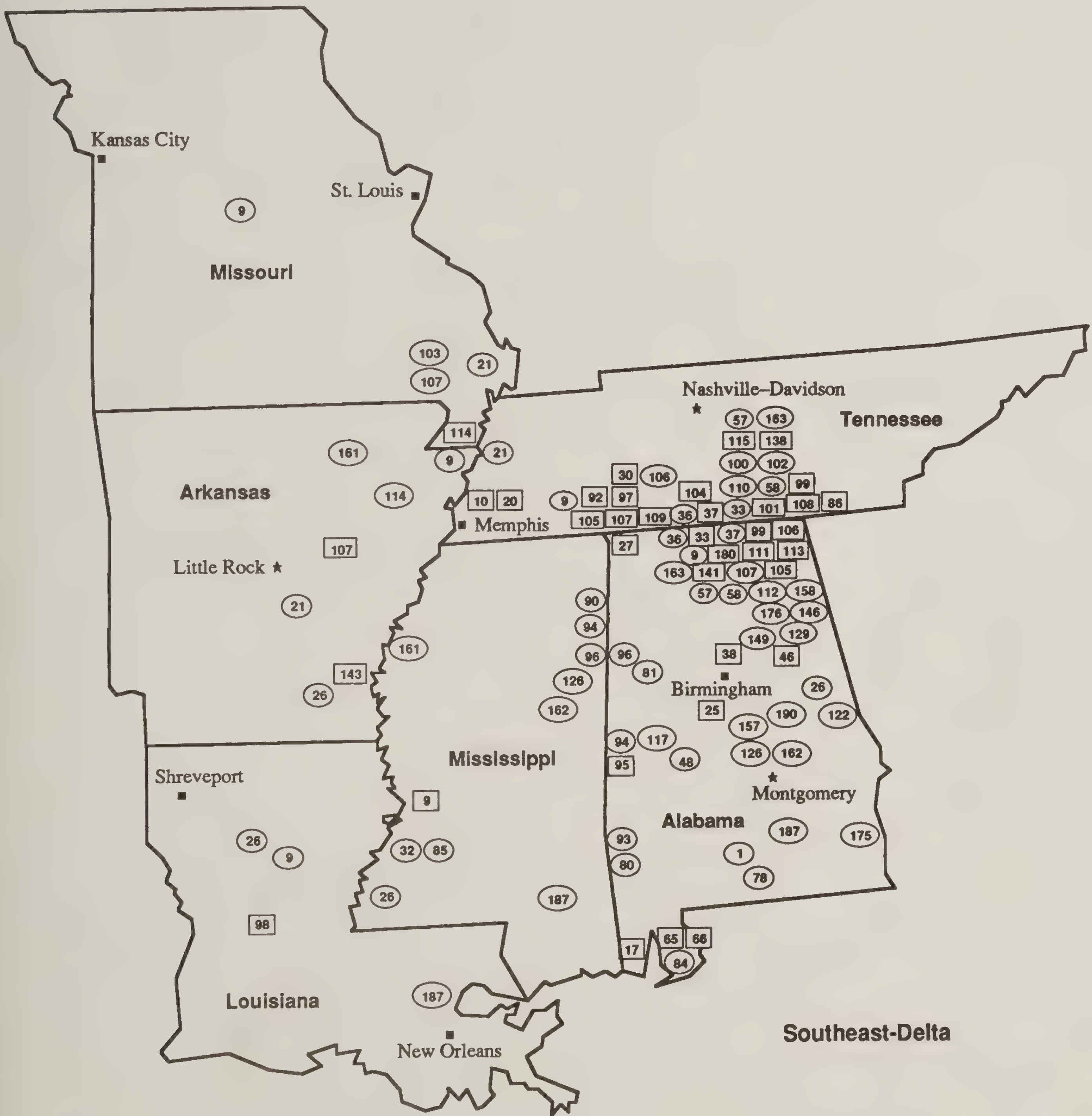


Figure B-3. Endangered and Threatened Species Habiitat Locations in the South Central Region

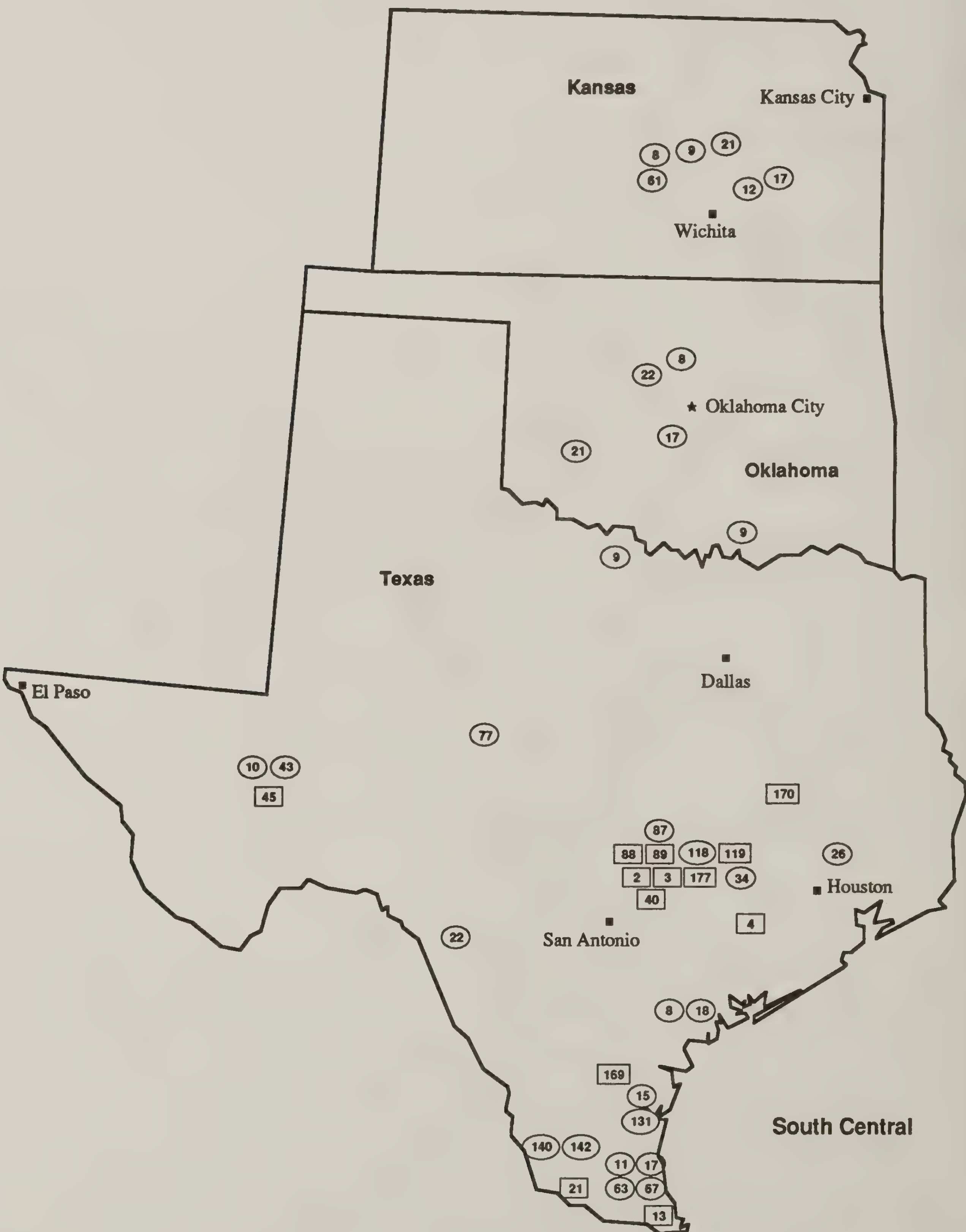
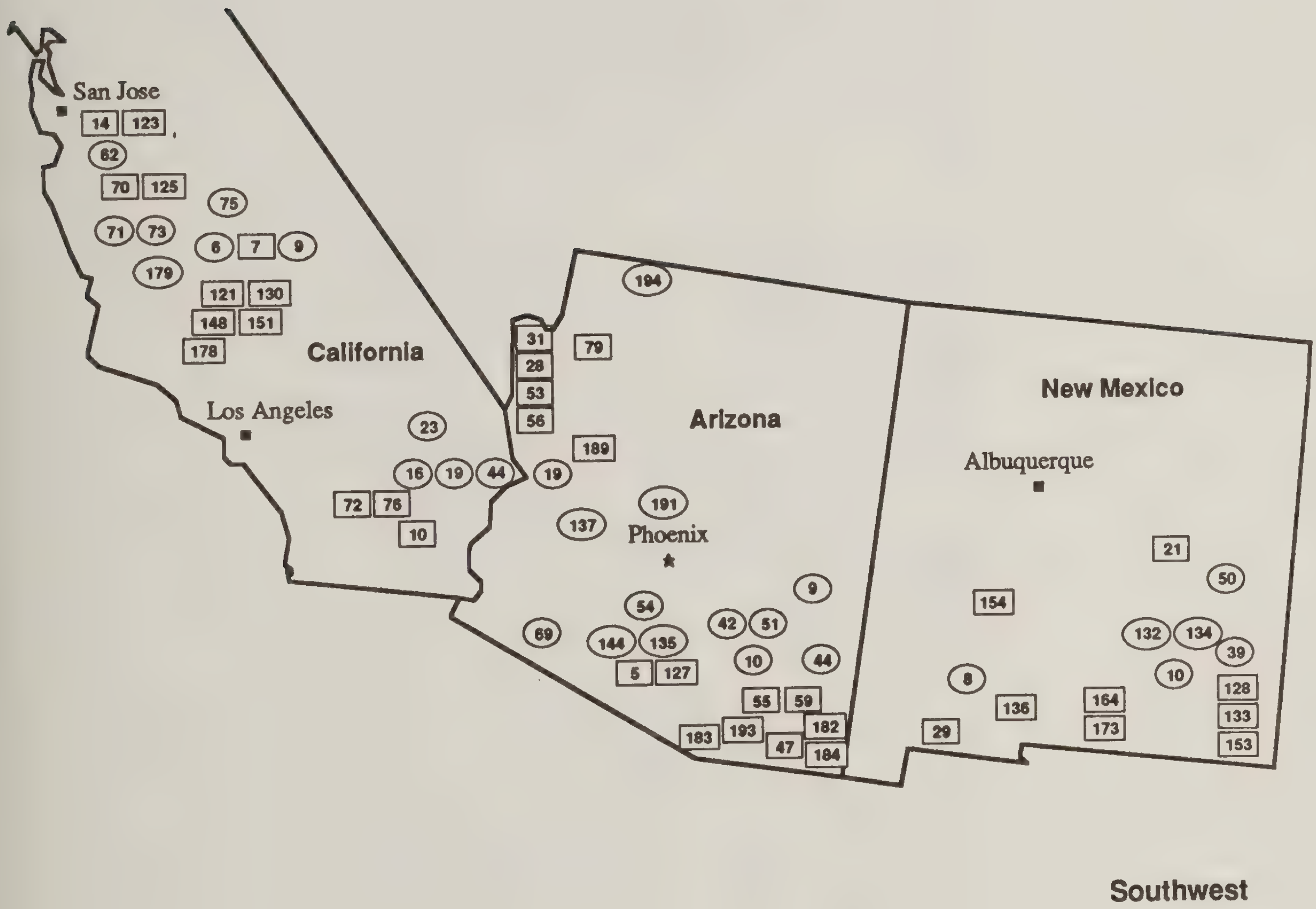


Figure B-4. Endangered, Threatened, and Proposed Species Habitat Locations in the Southwest Region



Key to Species Habitat Location Maps

Amphibians

Birds

Fish

Mammals

Reptiles

Snails

Arachnids

Clams

Insects

Plants

Crustaceans

Appendix H

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Appendix I

Implementation of the Program in Alabama

This appendix describes the potential effects of implementing the National Cooperative Boll Weevil Control Program in central and northern Alabama. The existing control program, the Southeast Boll Weevil Eradication Program, has been operating in the 21 counties of southern Alabama since 1987. This appendix was originally part of the two-part supplement to the draft EIS published on July 29, 1991.

Section 1 describes the purpose and need for implementing the proposed increment in central and northern Alabama. Section 2 describes the preferred alternative—eradication with Full Federal involvement—the no action alternative; and current grower practices in southern, central, and northern Alabama. Section 3 contains a detailed description of the environmental resource elements in Alabama that may be affected by the program. Section 4 contains an analysis of the potential impacts of expanding the existing program into central and northern Alabama. Attachment A contains a discussion of the environmental fate and transport modeling, the human health risk assessment, and the nontarget species risk assessment. Attachment B describes the endangered, threatened, and proposed plant, wildlife, and aquatic species that occur in Alabama's cotton-producing counties, their habitats, and the possible effects the program may have on them.

Section 1

Purpose and Need

Introduction

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), in cooperation with the Alabama Department of Agriculture and Industries and the Southeast Boll Weevil Eradication Foundation, proposes to implement the National Boll Weevil Cooperative Control Program in central and northern Alabama. Alabama is part of the proposed National Boll Weevil Cooperative Control Program described and evaluated in the EIS.

This appendix presents information not included in the draft EIS about the existing boll weevil eradication program in southern Alabama and evaluates the proposed implementation of the program in the rest of the State. Program details and impacts that are the same in Alabama as in the rest of the Cotton Belt are not repeated in this appendix; where appropriate, the text refers the reader to parts of the final EIS.

This section discusses the purpose of and need for implementing the National Boll Weevil Cooperative Control Program in Alabama. The status of previously eradicated areas in the national program is also presented. Section 2 describes the National Boll Weevil Cooperative Control Program's preferred alternative, eradication with full Federal involvement, as it would be specifically implemented in central and northern Alabama. Section 3 describes Alabama's environmental resources, and section 4 evaluates the potential impacts of eradication on these resources. Section 5 explains the conclusions reached about the potential environmental impacts of implementing the control program in central and northern Alabama. Details about the environmental fate modeling of the program insecticides and the human health and wildlife risk assessments are presented in attachment A. Attachment B describes the federally listed endangered, threatened, and proposed plant and wildlife species in Alabama, analyzes the potential effects of the control program on these species, and describes measures to protect those species.

Purpose

The first chapter of the EIS describes the purpose of the National Boll Weevil Cooperative Control Program. The objective of implementing the program in central and northern Alabama is to eradicate the boll weevil as an economic pest in Alabama. Achieving this objective will help maintain the previously eradicated areas in the Southeast (Florida, Georgia, South Carolina, North Carolina, and Virginia). The program's success in achieving previous increments has demonstrated the feasibility of the eradication alternative. APHIS and program cooperators recognize that some cotton producers and members of the scientific community question the feasibility of eradication. The ultimate goal of eradication is to eliminate the boll weevil, thereby reducing the total amount of pesticides used in cotton production.

Need for Eradication

Alabama is the eighth largest producer of cotton in the United States. Moreover, cotton is Alabama's second most valuable crop (after peanuts), with cash receipts totaling $120 million in 1988. Cotton revenues represented 15 percent of total crop receipts in 1988 and 5 percent of all farm commodity receipts (Alabama Department of Agriculture and Industries (ADAI), 1990).

The boll weevil is the single largest source of cotton damage in Alabama. Continuing crop losses from the boll weevil and the resultant high annual control costs are principal contributors to the high cost of producing cotton in Alabama. Between 1981 and 1984, the boll weevil was responsible for 5 percent of the total loss of cotton yield caused by insects and mites; four other major cotton pests (*Heliothis* spp., plant bugs, thrips, and spider mites) were responsible for a total yield loss of 6 percent. Cotton growers' annual control costs averaged $54.48 per harvested acre for boll weevil and *Heliothis* spp. control and $65.32 per harvested acre for controlling all cotton insects and mites. The value of the cotton destroyed by the boll weevil and the cost of boll weevil control averaged $21.9 million annually, 67 percent of the total value of the $32.8 million cost of cotton yield loss and control of all cotton pests (Suguiyama and Osteen, 1988).

The boll weevil (*Anthonomus grandis*) immigrated into the United States from Mexico and into Alabama in the early 1900s. Because the boll weevil does not have many natural enemies, chemical insecticides are heavily relied upon for controlling this pest. Boll weevils overwinter in well-drained, protected places in and around cotton fields and come out of hibernation to enter cotton fields in May and June. A surge of emerging weevils often occurs after a spring rain. A complete life cycle requires approximately 3 weeks, allowing five generations to occur annually in Alabama.

Authority exists under the Organic Act of 1944, as amended (7 U.S.C. 147a), for the Secretary of Agriculture to cooperate with the States or political subdivisions thereof; farmers' associations and similar organizations; and individuals to detect, eradicate, suppress, control, prevent, or retard the spread of plant pests. The Alabama Boll Weevil Eradication Act of 1984 (84-786) allows the Boll Weevil Eradication Foundation of Alabama to participate in the Southeastern Boll Weevil Eradication Program (SEBWEP).

Section 2

Alternatives

Overview

This section describes how the National Boll Weevil Cooperative Control Program's preferred alternative, eradication with full Federal involvement, would be implemented in central and northern Alabama (fig. 2-1). Current grower practices (those not funded by the Animal and Plant Health Inspection Service (APHIS)) that would constitute the no action alternative are explained, as is the feasibility of an integrated pest management (IPM) alternative in Alabama. This section also briefly reiterates the control methods now used in the 21 southern counties and discusses which of the control methods described in the final EIS would be available for use when the program begins in central and northern Alabama. Standard operating procedures and a summary of potential impacts of implementing the preferred alternative in Alabama are also included.

The other alternatives—eradication with limited Federal involvement, suppression with full Federal involvement, suppression with limited Federal involvement, nonchemical control only, and direct subsidy to growers—will not be evaluated here. Chapter 2 of the EIS contains a full discussion of those alternatives.

Current Alabama Cotton Grower Practices

Northern Alabama

Planting and Harvesting Practices

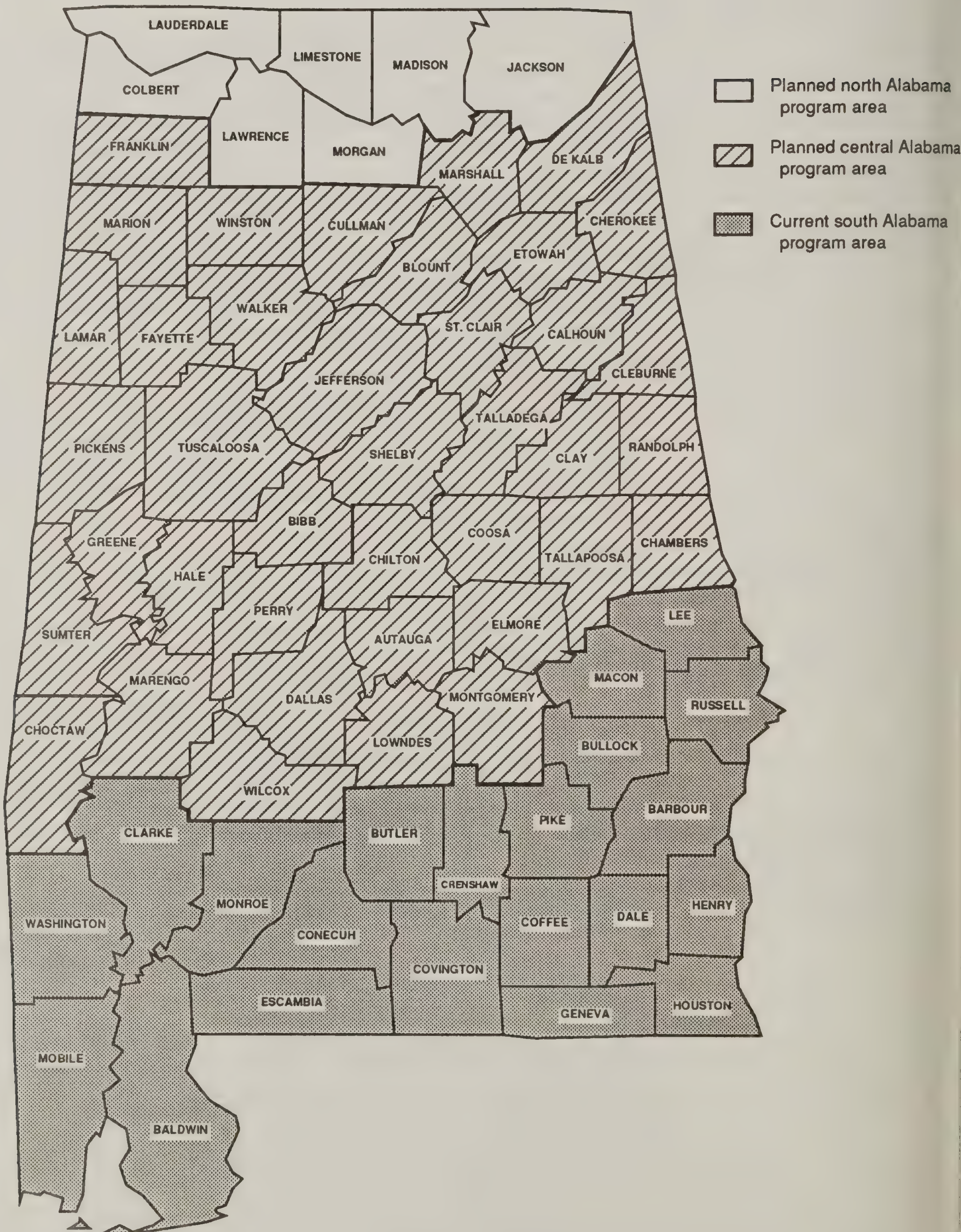
Between 1985 and 1988, an average of 179,103 acres (5.65 percent of the total land area in the northern counties) of cotton was planted in northern Alabama (Alabama Agricultural Statistics Service, 1988). The largest number of acres was planted in Limestone County, with an average of 51,800; the fewest acres were planted in Jackson County, with an average of 643.

Planting dates vary with the severity of a region's winter. Most cotton in northern Alabama is planted during April. If winters are especially mild, some planting may occur in late March; if they are colder than normal, planting may continue into early May.

The cotton varieties planted in northern Alabama consist only of regular-season cotton varieties, with DPL® 50 being the most widely used. Other common varieties include Stoneville® 453, DES® 119, KC® 380, and to a lesser extent, Stoneville® 825. Short-season cotton varieties are not used in northern Alabama, according to a personal communication with Barry Freeman, extension entomologist (1990).

Growers chemically manipulate cotton growth to facilitate the harvest and reduce insect problems. For example, when cotton becomes too tall

Figure I-2-1. Current and Planned Program Areas



or its vegetative growth is excessive, it is difficult to harvest efficiently, the efficiency of insecticide applications may be reduced, and the cotton may be more prone to boll rot (Alabama Cooperative Extension Service, 1990). In addition, delayed fruiting and excessive vegetative growth (which provides more shade and moisture) encourage higher, longer lasting insect infestations during the growing season. To help alleviate these situations, PIX® (mepiquat-chloride), a cotton growth regulator, is used by 80 percent of the growers on approximately 80 percent of their fields. PIX® slows plant growth, resulting in a more compact plant with clustered bolls, and causes cotton to mature earlier (Alabama Cooperative Extension Service, 1990). (Cotton treated with PIX® matures 4 to 7 days earlier than untreated cotton, according to a personal communication with Barry Freeman, 1990.) In addition, because PIX® reduces vegetative growth and encourages early fruiting, it helps combat late-season insect populations (Alabama Cooperative Extension Service, undated).

Chemical defoliants are also used to facilitate the harvest. The most commonly used defoliant in northern Alabama is Dropp®, which causes squares, as well as leaves, to fall and discourages cotton regrowth. When the squares fall from the plant, they begin to rot, and most of the young boll weevils inside will die.

After the harvest, growers generally destroy the cotton stalks. There is no mandatory date for cotton-stalk destruction in northern Alabama; however, because of the heavy clay soil in that part of the State, most growers shred the stalks as soon after the harvest as possible (sometimes shredders are in the same field behind the cotton pickers) and plow soon after to break up the soil. If plowing were left until spring, the clay soil would be difficult to break up because of the compaction that occurs during winter freezes. Erosion is usually not a problem unless winter rains are heavy, according to a personal communication with Barry Freeman (1990).

Cotton Pest Control

Each field is scouted once or twice a week for pests. Either the grower, an Extension Service-trained scout, or a professional consultant does the scouting (Alabama Cooperative Extension Service, undated). The important cotton insect pests in northern Alabama are thrips, aphids, budworms and bollworms (*Heliothis* spp.), tarnished plant bugs, spider mites, and boll weevils. These pests are controlled as follows (table 2-1 lists the active ingredient, application rates, number of applications, and percentage of acreage receiving treatments during the season):

The following information was obtained from a personal communication with Dr. Ron Smith, Auburn University (1990).

- Thrips—Ninety percent of the fields in northern Alabama are treated with an in-furrow application of the systemic insecticides Temik®, Thymet®, or Disyston® at planting. Temik® is used

Table 2-1. Pesticides Likely To Be Used in Current Grower Practices in NORTHERN ALABAMA[a]

Trade name	Active ingredient	Rate of application (lb a.i./acre)	Number of applications	Percent of fields treated	Time of year	Pests targeted
Temik®	Aldicarb	3.5–4 lb/acre	1	90	Planting	Thrips
Orthene®	Acephate	0.15 lb/acre	1 treatment from among these pesticides	50	April–May	Thrips
Bidrin®	Dicrotophos	0.15 lb/acre				
Cygon®	Dimethoate	0.15 lb/acre				
Methyl parathion	Methyl parathion	0.33 lb/acre	1	50	June	Boll weevils[b]
Vydate®	Oxamyl	0.225–0.9 lb/acre	1	10	June	Boll weevils[b]
Larvin®	Thiodicarb	0.5 lb/acre	1 treatment from among these pesticides	33	June	*Heliothis* spp.
Curacron®	Profenofos	0.5 lb/acre				
Various pyrethroids		0.25–0.5 lb/acre				
Orthene®	Acephate	0.5–1 lb/acre	1 treatment from among these pesticides	60	June	Tarnished plant bug
Bidrin®	Dichrotophos	0.1–0.5 lb/acre				
Pyrethroids		label rate				
Methyl parathion	Methyl parathion	0.25–2 lb/acre				
Bidrin®	Dicrotophos	0.1–0.5 lb/acre	1.5 treatments of one or the other pesticides	100	June	Aphids
MetaSystox–R®	Oxydemeton	0.25–0.5 lb/acre				
Karate®	Lambda cyhalothrin	0.25 lb/acre	3 treatments from among these pesticides	100	July–August	*Heliothis* spp.
Baythroid®	Cyfluthrin	0.028 lb/acre				
Asana®	Esfenvalerate	0.03 lb/acre				
Ammo®	Cypermethrin	0.05 lb/acre				
Methyl parathion	Methyl parathion	0.33 lb/acre	3 to 6 treatments from among these pesticides	100	July–August	Boll weevils[b]
Guthion® 2S	Azinphos-methyl	0.25 lb/acre				
Karate®[c]	Lambda cyhalothrin	0.025 lb/acre				
Baythroid®[c]	Cyfluthrin	0.028 lb/acre				

Table 2-1. Pesticides Likely To Be Used in Current Grower Practices in NORTHERN ALABAMA[a] (continued)

Trade name	Active ingredient	Rate of application (lb a.i./acre)	Number of applications	Percent of fields treated	Time of year	Pests targeted
Curacron®	Profenofos	0.5 lb/acre	1 treatment from among these pesticides	25	Any time	Spider mites
Lorsban®	Chlorpyrifos	0.5 lb/acre				
Capture®	Bifenthrin	0.5 lb/acre				

[a] Applications may be ground or aerial, depending on individual circumstances.
[b] If boll weevils are present.
[c] If *Heliothis* spp. are also present.

approximately 75 percent of the time. Granular formulations of these insecticides are dropped in the planting furrow with the cottonseed. Approximately 50 percent of the acreage receives a foliar application of either Orthene®, Bidrin®, or Cygon® on seedlings for further control when the cotton is in the two- to four-true-leaf stage. These insecticides are applied with ground equipment during cultivation. A single nozzle directed a few inches above the plants sprays a 10-inch swath.

- Aphids—Aphids are a greater problem in northern Alabama than in other parts of the State. They have also become resistant to most insecticides. Nevertheless, all growers treat their cotton at least once during the season, between July 15 and August 1, when cotton is reaching its peak fruiting period, and about half of them treat twice—usually with Bidrin® or Metasystox-R®. The insecticide is usually applied with ground equipment.

- *Heliothis* spp.—Early-season (June 15 to June 20) control of budworms and bollworms is needed on approximately one-third of the cotton acreage. Larvin®; Curacron®; or a pyrethroid such as Karate®, Baythroid®, Asana®, Cymbush®, Ammo®, or Scout® is normally used. In-season (July 20 to August 20) pesticide applications include treating for budworms and bollworms with Karate®, Baythroid®, Asana®, or Ammo®. Approximately 80 percent of the treatments are done using ground equipment, and approximately 20 percent of the treatments are done with aircraft.

- Tarnished plant bug—An estimated 60 percent of the cotton in northern Alabama is usually treated for this early-season (June 15 to July 1) pest with Orthene®, Bidrin®, one of the pyrethroids, or methyl parathion. Treatments are done with ground equipment about 80 percent of the time and by aircraft about 20 percent of the time.

- Spider mites—Spider mites can be a problem anytime throughout the growing season, though they more typically become a problem in mid- to late season. Approximately 25 percent of the cotton acreage is usually treated with Curacron®, Lorsban®, or Capture® to control spider mites. Approximately 20 percent of the applications are aerial, and approximately 80 percent are done with ground equipment.

- Boll weevils—Boll weevils are a cyclic problem in northern Alabama. Higher populations usually occur after warm winters. In years when they are an economic problem, approximately 50 percent of the acreage will receive a pinhead-square treatment of methyl parathion, and 10 percent will be treated with Vydate®. Ground equipment is used for these applications in early to mid-June (June 5 to June 20). Multiple treatments with organo-phosphates early in the season are usually avoided because they eliminate beneficial insects; also, the tarnished plant bug and

aphids are resistant to them, thus increasing the probability of uncontrollable infestations of these two species. The selection of chemicals for treating boll weevils in July and August depends on the presence or absence of *Heliothis* spp. If growers are having a problem with boll weevils but not *Heliothis* spp., they may use up to six in-season applications of methyl parathion or Guthion® on all the fields. These are applied by ground equipment (80 percent) and by aircraft (20 percent). If *Heliothis* spp. are also present, growers would probably use Karate® or Baythroid®. During years when boll weevils are a problem, growers mix methyl parathion with their defoliant, which is applied aerially.

Central Alabama

Planting and Harvesting Practices

The average number of cotton acres planted in central Alabama from 1985 to 1988 was 101,495 (0.57 percent of the total land area), ranging from a high in Dallas County of 15,790 to a low in Winston, Clay, Coosa, and Randolph Counties, where no cotton was planted (Alabama Agricultural Statistics Service, 1988).

In central Alabama, most cotton is planted between April 15 and May 15 of each year. Planting may begin a little earlier or a little later, depending on the temperature and the timing of spring rains.

The most common cotton varieties planted are DPL® 90, DPL® 50, Coker® 315, DES® 119, Stoneville® 456, and DPL® 41. Short-season varieties are not used often; they do not produce well because of central Alabama's erratic rainfall.

Chemical defoliants are used in central Alabama to facilitate harvest. Defoliants reduce the risk of boll rot and can facilitate the picking schedule. Dropp®, a commonly used defoliant, also discourages regrowth.

Though not mandatory, stalks are shredded as soon as possible after harvest and left in place through the winter to help prevent erosion.

Cotton Pest Control

In a normal year in central Alabama, growers use 6 to 12 insecticide applications per cotton field, with an average of 8. The need for an application is determined by scouting each field. The important cotton pests in central Alabama are thrips, aphids, spider mites, whiteflies, *Heliothis* spp., and boll weevils; *Heliothis* spp., aphids, and boll weevils cause the most damage. These pests are controlled as follows (table 2-2 lists the active ingredient, application rates, number of applications, and percentage of the acreage receiving treatments during the season), according to a personal communication with Dr. Ron Smith (1990):

- Thrips—Temik® is applied with the cottonseed in furrows at planting. A granular formulation of this insecticide is dropped in

Table 2-2. Pesticides Likely To Be Used in Current Grower Practices in CENTRAL ALABAMA[a]

Trade name	Active ingredient	Rate of application (lb a.i./acre)	Number of applications	Percent of fields treated	Time of year	Pests targeted
Temik®.	Aldicarb	3.5 lb/acre	1.5	40	April-May planting	Thrips
Bidrin®	Dicrotophos	0.2 lb/acre	1	30	May	Thrips
Di-Syston®	Disulfoton	7 lb/acre	1	20	May	Thrips
Methyl parathion	Methyl parathion	0.25 lb/acre	1.5	40	June	Boll weevil
Karate®	Lambda cyhalothrin	0.025 lb/acre	6	30	June	*Heliothis* spp.
Baythroid®	Cyfluthrin	0.028 lb/acre	6	30	June	*Heliothis* spp.
Asana®	Esfenvalerate	0.03 lb/acre	6	20	June	*Heliothis* spp.
Cymbush®/Ammo®	Cypermethrin	0.05 lb/acre	6	15	June	*Heliothis* spp.
Scout®	Tralomethrin	0.018 lb/acre	6	5	June	*Heliothis* spp.
Bidrin®	Dicrotophos	0.2 lb/acre	1.5	40	June	Spider mites, whiteflies, aphids, and plant bugs
MetaSystox-R®	Oxydemeton	0.125 lb/acre	1.5	40	June	
Curacron®	Profenofos	0.5 lb/acre	At least 1 treatment from among these pesticides	50	June	Spider mites, whiteflies, aphids, and plant bugs
Lorsban®	Chlorpyrifos	0.5 lb/acre				
Swat®	Phosphamidon	0.25 lb/acre				
Monitor®	Methamidophos	0.25 lb/acre				
Orthene®	Acephate	0.5 lb/acre				
Larvin®	Thiodicarb	0.5 lb/acre	1	30	June	Beet armyworm
Guthion® 2S	Azinphos-methyl	0.25 lb/acre	4	50	July–August	Boll weevil
Methyl parathion	Methyl parathion	0.25 lb/acre	4	50	July–August	Boll weevil

[a] Applications may be ground or aerial, depending on individual circumstances.

the planting furrow with the cottonseed. Bidrin® and Di-Syston® are also used shortly after the seedlings emerge.

- Aphids, spider mites, and whiteflies—These pests are treated in the early season with Bidrin® and Metasystox-R® and at least one treatment of one of the following: Curacron®, Lorsban®, Monitor®, or Orthene®.

- *Heliothis* spp.—*Heliothis* spp. are treated approximately six times with any one of the following pyrethroids: Karate®, Baythroid®, Asana®, Cymbush®, Ammo®, or Scout®.

- Boll weevils—Methyl parathion is applied in June (early season) to control overwintered boll weevils; approximately one-half the cotton acreage is treated four times in July and August (in season) with Guthion® 2S or methyl parathion.

- Beet armyworm—A single, aerial application of Larvin® is usually made in midseason (late July) if beet armyworms are a problem.

All modes of application are identical to those used in northern Alabama except where specified.

Southern Alabama

Planting and Harvesting Practices

From 1985 to 1988, an average of 61,268 acres of cotton was planted (0.55 percent of the total land area) in southern Alabama. The largest number of acres was planted in Monroe County, with an average of 8,750; Clarke County had the fewest acres, with an average of 158 (Alabama Agricultural Statistics Service, 1988).

Growers in southern Alabama use planting and harvesting practices similar to those in central Alabama, according to a personal communication with Dr. Ron Smith (1990).

Cotton Pest Control

As with planting and harvesting practices, cotton pests and the control methods used in southern Alabama are similar to those in central Alabama, with the exception of the following (see table 2-3 for information on the active ingredient, application rates, number of applications, and percentage of acreage receiving treatments during the season):

- Beet armyworm—The beet armyworm, a migratory insect that starts in the south and progresses north, is a greater economic problem in southern Alabama than in other parts of the State. An estimated six applications of Larvin® at a rate of 0.5 lb a.i./acre are usually made on about 30 percent of the cotton acreage. Another 20 percent of the acreage is treated three times with Curacron® at a rate of 1 lb a.i./acre, and Dimilin® is applied on 30 percent of the

Table 2-3. Pesticides Likely To Be Used in Current Grower Practices in SOUTHERN ALABAMA[a]

Trade name	Active ingredient	Rate of application (lb a.i./acre)	Number of applications	Percent of fields treated	Time of year	Pests targeted
Temik®	Aldicarb	3.5 lb/acre	1.5	40	April planting	Thrips
Bidrin®	Dicrotophos	0.2 lb/acre	1	30	May	Thrips
Di-Syston®	Disulfoton	7.0 lb/acre	1	20	May	Thrips
Karate®	Lambda cyhalothrin	0.025 lb/acre	6	30	June	*Heliothis* spp.
Baythroid®	Cyfluthrin	0.028 lb/acre	6	30	June	*Heliothis* spp.
Asana®	Esfenvalerate	0.03 lb/acre	6	20	June	*Heliothis* spp.
Cymbush®/Ammo®	Cypermethrin	0.05 lb/acre	6	15	June	*Heliothis* spp.
Scout®	Tralomethrin	0.018 lb/acre	6	5	June	*Heliothis* spp.
Bidrin®	Dicrotophos	0.2 lb/acre	1.5	40	June	Spider mites, whiteflies, aphids, and plant bugs
MetaSystox-R®	Oxydemeton	0.125 lb/acre	1.5	40	June	Spider mites, whiteflies, aphids, and plant bugs
Curacron®	Profenofos	0.5 lb/acre	At least 1 treatment from among these pesticides	50	June	Spider mites, whiteflies, aphids, and plant bugs
Lorsban®	Chlorpyrifos	0.5 lb/acre				
Swat®	Phosphamidon	0.25 lb/acre				
Monitor®	Methamidophos	0.25 lb/acre				
Orthene®	Acephate	0.5 lb/acre				
Larvin®	Thiodicarb	0.5 lb/acre	1	30	June	Beet armyworm
Larvin®	Thiodicarb	0.5 lb/acre	6	30	July–August	Beet armyworm
Curacron®	Profenofos	1.0 lb/acre	3	20	July–August	Beet armyworm
Dimilin®	Diflubenzuron	1 to 2 oz/acre	3	30	July–August	Beet armyworm

[a] Applications may be ground or aerial, depending on individual circumstances.

acreage two or three times during the season at a rate of 1 to 2 oz a.i./acre.

- Boll weevils—Since the beginning of the Southeast Boll Weevil Eradication Program in 1987, no growers in the 21 southern counties have used boll weevil treatments.

All modes of application are identical to those used in northern and central Alabama except where specified.

The Current Boll Weevil Eradication Program

Organization of the Southeast Boll Weevil Eradication Program

The Southeast Boll Weevil Eradication Program (SEBWEP) is a cooperative Federal-State-cotton producer program designed to eradicate the boll weevil as an economic cotton pest within the Southeastern United States. The Southeastern Boll Weevil Eradication Foundation, Inc. (Southeastern Foundation), is a nonprofit corporation. The Southeastern Foundation is made up of the Boll Weevil Eradication Foundations of Alabama, Florida, Georgia, North Carolina, and South Carolina; and the Virginia Department of Agriculture and Consumer Services. The Southeastern Foundation is the grower organization that cooperates with USDA APHIS-Plant Protection and Quarantine (PPQ) in implementing and operating SEBWEP.

The Board of Directors of the Southeastern Foundation consists of three board members (one regulatory and two growers) from each State who are elected by the individual State foundations. The Chairman, Vice Chairman, and Secretary/Treasurer are elected by the Board of Directors for a 1-year term. The Southeastern Foundation hires employees to work with USDA APHIS employees in conducting the activities of SEBWEP. Field unit supervisors meet the basic standards for USDA GS-5 Plant Protection Technicians. The Southeastern Foundation, in cooperation with USDA APHIS and in coordination with the cooperative agreement between the Southeastern Foundation and USDA APHIS (SEBWEP, 1989), provides permanent and temporary field and office personnel to conduct program activities; assists in organizing educational and informational meetings for cotton growers; assists in resolving grower concerns about program activities; and solicits bids and issues contracts, in cooperation with USDA APHIS for pesticide purchases, aerial pesticide applications, and other materials and services needed for program operation; and provides traps for the program from plastic injection molds and other equipment (SEBWEP, 1989).

Each State foundation collects grower assessments and remits them to the Southeastern Foundation to conduct SEBWEP—excluding $2,000 for the State foundations' annual meeting and other amounts needed to prepare annual audits. The Southeastern Foundation is responsible for

accounting for all funds, including the 30 percent provided by USDA APHIS PPQ (SEBWEP, 1989).

The SEBWEP has changed over its duration in response to local concerns. Some of those concerns have alleged fishkills, human illness, spraying occupied fields, pesticide drift, and animal or livestock illness. Table 2-4 summarizes the complaints received by program staff from 1987 to 1990 and their responses. As the program proceeded, a system to respond to and resolve complaints was created. Investigation of these complaints revealed that several of them appeared valid, and APHIS program procedures were modified to minimize the risk of future occurrences. Many of these risks were minimized by improving pilot education, adjusting spray equipment, reducing spray height, notifying potentially affected parties in advance, and eliminating the use of azinphos-methyl in Alabama. In some instances, contract pilots were terminated from the program for improper pesticide application. Program personnel have also been assigned to observe applications to fields near complainants' homes, and dyecards have been used to detect drift, if any. Some of the mitigation measures found in chapter 2 of the EIS were developed in response to local concerns. A more complete analysis of the complaints may be found in the 1988 Spring-Summer Boll Weevil Suppression Program Environmental Assessment (USDA, 1988).

The Southeast Boll Weevil Eradication Program in Alabama

Program Organization. The southeast program is divided into three areas, which are subdivided into 10 work units ranging in size from approximately 20,000 to 46,000 acres. There are two work units within the 21-county program area in Alabama. One is headquartered in Eufaula, Alabama; the other is in Jay, Florida. Each work unit is staffed by the following APHIS employees: an Officer-in-Charge (OIC), an Assistant-Officer-in-Charge (AOIC), and a Plant Protection and Quarantine (PPQ) Officer; in addition, the Southeastern Foundation provides a secretary, 8 to 10 field unit supervisors responsible for day-to-day operations, and 40 to 50 trappers.

Alabama Program Operations. The eradication program began in the 21 southern Alabama counties in the fall of 1987 with 10 to 12 diapause applications of ultra low volume (ULV) Guthion®. The following spring, Guthion was replaced with ULV malathion.

Malathion is the only insecticide now used in the program area in Alabama. A ULV formulation is applied aerially on 98 percent of the acres treated. The other 2 percent of the acres are not suitable for aerial treatment; a ready-to-use (RTU) formulation is applied with high-clearance ground equipment on these acres. Pheromone traps in and

Table 2-4. Summary of Types of Complaints

A. Problem with pesticide application (originates from the public and possibly cotton growers)

A1. Fishkill
A2. People sprayed—human illness
A3. Livestock/fowl illness
A4. Sprayed houses, cars, etc.
A5. Bee kill
A6. Spraying in wind above 10 mph—excessive drift
A7. Flying too high
A8. Spraying outside target area
A9. Pesticide spill or dump
A10. Aircraft turning too close to house or school

B. Quality and scheduling of pesticide application (originates from cotton growers)

B1. Aircraft observers not adequately monitoring treatment
B2. Program aircraft interfere with private aircraft
B3. Field not treated
B4. Field not treated on time
B5. Inadequate field coverage
B6. Grower not adequately informed of treatment schedule
B7. Inadequate control—boll weevil damage detected

C. Trapping operation (originates from cotton growers)

C1. Field not trapped
C2. Not enough traps around the field
C3. Poor spacing or placement of traps
C4. Traps not serviced properly
C5. Crop damaged by program vehicles

D. General program administration and management (originates from the public and cotton growers)

D1. Unprofessional behavior by program personnel
D2. Disagreement with program policy, regulations, or their enforcement

KEY

Types of Response, Followup, and Corrective Action

1. Contacted person filing complaint as soon as possible
2. Investigated by field supervisor
3. Investigated by USDA personnel (OIC, AOIC, PPQ Officer)
4. Referred to State regulatory personnel (complaint not related to SEBWEP)
5. Interaction/investigation with State regulatory personnel
6. Samples taken for residue analysis
7. Corrective action taken with pilot or aircraft
8. Chemical cleanup (spill or dump)
9. Reapplication due to inadequate treatment
10. Used ground equipment for pesticide applications
11. Changed timing of applications
12. Notified farmer of treatment dates
13. Sprayed field previously missed
14. Scouted field for weevil damage
15. Conducted weevil mortality tests
16. Installed traps
17. Increased number of traps
18. Improved spacing or placement of traps
19. Serviced traps
20. Trapper instructed to walk or use ATV
21. Counseled program personnel about behavior

Table 2-4. **Summary of Types of Complaints (continued)—Complaints Received on SEBWEP—1987**

Type of complaint[1]	No. of complaints	Type of response, followup, and corrective action[2]	Valid complaints[3]
A1	7	1, 2, 3, 5, 6	4
A2	10	1, 2, 3, 6, 7, 12	7
A3	3	1, 3	
A4	7	1, 3, 5, 6, 7, 12	3
A5	1	1, 3	
A6	5	2	
A7			
A8			
A9			
A10	4	3, 10, 11	3
B1			
B2			
B3			
B4			
B5			
B6			
B7			
C1			
C2			
C3			
C4			
C5			
D1			
D2	2	3	
TOTAL	39		17

[1] See the list of types of complaints.
[2] See the list of types of response, followup, and corrective action.
[3] As determined by investigation, the complaint was related to SEBWEP.

Table 2-4. Summary of Types of Complaints (continued)—Complaints Received on SEBWEP—1988

Type of complaint[1]	No. of complaints	Type of response, followup, and corrective action[2]	Valid complaints[3]
A1	3	1, 2, 3, 6	3
A2	7	1, 2, 3, 5, 6	5
A3	2	1, 3, 5	2
A4	4	2, 3, 6, 7, 10, 12	4
A5			
A6	2	1, 2, 3, 7	2
A7			
A8	1	1, 3	1
A9			
A10	3	3, 6, 7	3
B1	1	1, 2, 3, 12	1
B2			
B3	5	1, 2, 3, 12, 13	5
B4	3	2, 3, 11, 12, 14	3
B5	4	1, 2, 3, 6, 13, 14	4
B6	2	3, 12, 14	2
B7	6	2, 3, 10, 11, 14, 17	6
C1	6	2, 3, 16	6
C2			
C3	2	1, 2, 3, 19	2
C4	6	1, 2, 3, 12, 19	6
C5	4	1, 2, 3, 20	4
D1			
D2	2	2, 3, 11	2
TOTAL	63		61

[1] See the list of types of complaints.
[2] See the list of types of response, followup, and corrective action.
[3] As determined by investigation, the complaint was related to SEBWEP.

Table 2-4. Summary of Types of Complaints (continued)—Complaints Received on SEBWEP—1989

Type of complaint[1]	No. of complaints	Type of response, followup, and corrective action[2]	Valid complaints[3]
A1	1	3, 6	1
A2	4	1, 3, 7, 10, 11	4
A3	2	2, 3, 5, 12	2
A4	1	2, 3, 5, 12	1
A5	1	1, 3	1
A6	2	1, 3	2
A7			
A8	1	3, 6, 10	1
A9			
A10	1	2, 11	1
B1			
B2	1	2, 7, 12	1
B3			
B4			
B5	1	1, 2	1
B6			
B7	6	2, 3, 11, 14, 16	5
C1	2	2, 3, 14, 16	2
C2			
C3			
C4			
C5	5	1, 2, 3, 20, 21	5
D1			
D2			
TOTAL	28		27

[1] See the list of types of complaints.
[2] See the list of types of response, followup, and corrective action.
[3] As determined by investigation, the complaint was related to SEBWEP.

Table 2-4. Summary of Types of Complaints (continued)—Complaints Received on SEBWEP—1990

Type of complaint[1]	No. of complaints	Type of response, followup, and corrective action[2]	Valid complaints[3]
A1			
A2			
A3	3	3, 4, 6	1
A4	1	3, 6	1
A5			
A6	2	2, 3, 6	2
A7			
A8			
A9			
A10			
B1			
B2			
B3			
B4			
B5			
B6			
B7	1	2, 6	1
C1	3	2, 3, 16	3
C2			
C3	1	2, 16	1
C4	1	2, 19	1
C5	1	2, 21	1
D1			
D2	1	1, 2	1
TOTAL	14		12

[1] See the list of types of complaints.
[2] See the list of types of response, followup, and corrective action.
[3] As determined by investigation, the complaint was related to SEBWEP.

around each field are monitored to determine the need for chemical treatment. In the 21-county program area, the threshold for malathion treatment is two weevils per field during the pinhead-square stage of cotton development and five weevils per field after the cotton blooms. Trappers work from the end of April until the end of November, with each responsible for servicing the traps on about 1,000 acres of planted cotton. Pheromone traps are placed either every 125 feet around the perimeter of the field or one trap per acre, whichever is greater. Traps are located on the field's edge from mid-July to mid-September and a few feet back from the field's edge before mid-July and after mid-September. This minimizes interference with cultivation and harvest.

Postharvest stalk destruction is mandatory in the program area. Timely destruction of cotton stalks is beneficial because it lessens the number of diapause treatments required, eliminates the boll weevil's food source, and prevents weevils from overwintering in unopened bolls. In past years of the program, growers have received credit against the next year's assessment if they destroy their stalks by a certain date. The dates of destruction and the amount of credit given vary from year to year and are determined by the Southeastern Foundation's Board of Directors in the late summer or early fall. The dates and credits are dependent on the number of insecticide applications that would have to be made if the stalks were not destroyed. For example, in the 1989 season, if stalks were destroyed by October 1, a credit of $7 per acre was given; by October 15, $5 per acre; and by November 1, $3 per acre was given, according to a personal communication with Fred Planer (1990).

Implementation of the National Boll Weevil Cooperative Control Program in Central and Northern Alabama

The existing organizational structure of the Southeast Boll Weevil Eradication Program, as previously described, is expected to remain unchanged during implementation of the National Boll Weevil Cooperative Control Program in central and northern Alabama, according to a personal communication with Fred Planer (1990).

Control methods being considered for use in the program are discussed in the following subsections (table 2-5). Because volume 1 of the final EIS contains a detailed discussion of the control methods, not all of the information will be repeated here. However, the control methods for which new or updated information was available have been expanded to include that information.

Cultural Methods

Alabama's climate and growing conditions for cotton production vary from north to south. Some of the cultural techniques used in other areas of the Cotton Belt may not be successful in Alabama. Of the cultural control techniques discussed in the EIS, only postharvest stalk destruction is widely used and expected to continue during the program's implementation.

Table 2-5. Use of Control Methods in Program Regions in Alabama

Method	South	Central	North
Cultural:			
Stalk destruction	1	1	1
Crop rotation	2	2	2
Trap cropping	3	3	3
Short-season cotton varieties	3	3	2
Voluntary production relocations	2	2	2
Mechanical:			
Mass trapping	3	3	3
Sterile insect release	3	3	2
Chemical:			
Malathion	1	1	1
Diflubenzuron	2	2	2
Methyl parathion	2	1	1

1 = Generally incorporated in the eradication program.
2 = Could have limited use in the eradication program.
3 = Not expected to be used in the eradication program.

Postharvest Stalk Destruction

In Alabama, growers use a bush-hog to destroy stalks. A bush-hog is a large mower with horizontal rotary blades that is pulled behind a tractor to shred the stalks to within 2 inches of the ground. Stalk destruction is already widely used, and growers will be required to continue the practice throughout the program's implementation.

Short-Season Cotton Varieties

Short-season cotton varieties do not produce well in Alabama because of the State's erratic rainfall. If it does not rain during the fruiting period, yield is low. Because regular-season cotton varieties have a longer fruiting period, the chance of rainfall during their fruiting period is much greater, according to a personal communication with Dr. Ron Smith (1990).

Crop Rotation

Cotton is the most valuable row crop in Alabama except for peanuts (Alabama Agricultural Statistics Service, 1988). However, the Federal Government strictly controls peanut allotments; therefore, crop rotation

is limited to cotton growers who have peanut allotments and can alternate between the two crops. Crop rotation is not expected to be encouraged for program use because of the limited economic viability of alternative crops in Alabama.

Voluntary Crop Relocation

The program may encourage relocating cotton production from environmentally sensitive areas or areas difficult to treat either aerially or with ground equipment to less sensitive areas. Growers would participate in crop relocation on a voluntary basis. However, most areas in Alabama suitable for cotton production are already used for that purpose, so any relocation would be on a small scale.

In some sensitive areas, growers may be prohibited from growing cotton. If cotton is planted in these areas, the State would have the authority to destroy it as a nuisance crop.

Mechanical Method

Mechanical control by mass trapping of boll weevils with pheromone traps, as discussed in chapter 2 of the EIS, will probably not be implemented in the Alabama program area because it is too labor intensive and does not provide an acceptable level of control for an eradication effort. Pheromone traps are currently used for monitoring purposes only.

Sterile Insect Technique

As more is learned from research about the biology and genetics of the boll weevil, the suitability of using sterile weevils in sterile–insect-release control programs becomes more feasible. Although releasing sterile boll weevils is not yet a practical means of controlling large boll weevil populations, it may be useful in fields with only small numbers of weevils, in fields near sensitive areas where chemical treatments are not appropriate, or in fields difficult to reach by ground equipment.

In 1987 a test was conducted comparing the survival, sexual attractiveness, and mating propensity of three strains of boll weevils that were sexually sterilized by radiation (North et al., 1988). The tested strains included the strain reared at the Gast Rearing Facility in Starkville, Mississippi; an improved strain of sterilized weevils; and a control strain from the Boll Weevil Research Laboratory. Each of the three strains of irradiated weevils lived longer in the field than those in the laboratory. In the laboratory, the improved strain had a 14-day postirradiation survival rate of greater than 90 percent and had a 70-percent mating propensity 10 days after sterilization. The sexual attractiveness to wild females varied for the strains in different stages of the life cycle, with the Starkville strain being most attractive the first 5 days and the improved strain being most attractive after 5 days and for at least 15 days after irradiation, as tested in the field.

In 1988 a sterile boll weevil release experiment was conducted in Lamar, Fayette, and Tuscaloosa Counties in Alabama (Smith et al., 1989). The ratio of sterile to native weevils was never more than 10:1

during the aerial release period, and a measurable level of suppression during the peak fruiting period was obtained. By midseason, only a few fields had reached a treatment threshold level. The need for insecticide applications, including treatments for *Heliothis* spp. and other secondary pests, was greatly reduced over the entire test area.

Chemical Control

The chemicals available for use in the proposed program in central and northern Alabama are malathion, diflubenzuron, and methyl parathion. Based on economic and environmental considerations, malathion would be used most often for aerial and ground applications.

Aerial Application

Training. All APHIS personnel must successfully complete a pesticide certification program before they can plan, manage, or supervise the application of program treatments in Alabama. The APHIS pesticide certification program consists of two parts: a fumigation workshop and a self-instructional course in pesticide application consisting of three documents—*The New Pesticide User's Guide*, a textbook covering most of the basic information presented in the training; *Pesticide User's Reference*, a reference containing PPQ guidelines and work-related suggestions about many aspects of pesticide use; and a *Participant Workbook*, an eight-lesson workbook containing the self-instructional part of the course. A score of 80 percent or higher is required to pass the examination. Certification must be renewed every 3 years (USDA, 1990).

EPA requires pilots of agricultural aircraft to be certified applicators if they are applying diflubenzuron or methyl parathion. Most States, including Alabama, also require certification of aerial applicators of malathion. Only certified applicators will be used in the cooperative control program.

The certified aerial applicators used by the program also receive additional training from USDA pilots. The USDA pilots help program personnel assess the condition of contract aircraft, and they routinely monitor contractor performance during aerial applications.

Operations. Fixed-wing aircraft or helicopters would be used in Alabama for aerial applications of ULV spray formulations of malathion and diflubenzuron and a microencapsulated formulation of methyl parathion. High-volume aerial applications of program pesticides have been eliminated from the analysis despite lower drift volumes. The primary reasons for using ULV applications are lower program costs and longer periods of effective control. Compared to conventional spray formulations, significantly less ULV material is required to treat a given area. Thus, treatment aircraft can treat more acres in less time and use less fuel. Moreover, the effectiveness of ULV formulations is equal to or better than conventional methods.

Aerially applied insecticides are sprayed with special nozzles on spray booms mounted near the trailing edge of the aircraft wing. Swaths range from 60 to 125 feet, depending on the aircraft used. To minimize drift, insecticides will be applied 5 to 12 feet above the cotton canopy. If a field contains an obstruction, the aircraft may increase its spray altitude if the obstruction is not near a sensitive area or if it is not possible to use a ground application method for the area surrounding the obstruction.

Weather conditions are also a factor in determining when to conduct aerial applications. Some weather conditions may reduce the effectiveness of the operation or increase the potential for offsite drift or runoff. If the wind velocity is more than 10 miles per hour (mph) or if rainfall is imminent, aerial applications will be postponed or discontinued until conditions become more favorable.

Insecticide applications are monitored to determine whether all target areas have been treated satisfactorily and to determine whether another localized treatment is necessary. In areas where applications cannot be observed, oil-sensitive dyecards will be used to determine the uniformity and adequacy of applications. Dyecards may also be used to monitor the accuracy of applications near sensitive areas.

Ground Application

Where aerial insecticide applications are impractical or inappropriate, high-clearance ground equipment (hiboys) would be used. Mist blowers mounted on trucks would be used for treating the edges of fields not covered by aerial treatments because of trees or other obstacles. Ground equipment will be used on small fields, fields surrounded by trees, or fields near sensitive areas. The RTU formulation of malathion will be applied by hiboys, while mist blowers will apply the ULV formulation. Diflubenzuron and methyl parathion may be applied with either type of equipment.

Although stipulations about weather conditions are not as stringent for ground applications as for aerial applications, they are also considered when determining the timing of ground applications. Operators will stop applications when the chemical is not reaching the target effectively. If windspeeds exceed 15 mph or rainfall is imminent, treatments will be postponed until weather conditions improve.

Methods Eliminated From Detailed Study

Biological Control

There are no known effective predators, parasites, or microbial pathogens to control the boll weevil in Alabama. The major causes of mortality will vary among the regions infested. In a Texas field study, predation accounted for 58 percent of the mortality of immature boll weevils in the east-coastal region of Texas. Most of this mortality was attributable to the imported red fire ant (Sturm and Sterling, 1990). In the north-central region of Texas, the major causes of mortality were

fairly equally divided among desiccation (30 percent), predation (23 percent), and parasitism (23 percent). The major parasitoid of the boll weevil was found to be the wasp, *Bracon mellitor*. As discussed in the EIS, because of their lack of effectiveness, biological controls have been eliminated from the detailed analysis.

Attracticide

The Agricultural Research Service in Mississippi is developing an attracticide stick, which is a combination of a pheromone, a feeding stimulant, shellac, and an insecticide. This innovation may be useful in the future in areas where aerial spraying is prohibited and ground spraying is limited. It is still experimental and has not been proven in the field; therefore, it will not be considered in detail for use in the current program. However, if sufficient progress is made in developing this method, it may be considered for use later in the program.

Implementation of the Preferred Alternative—Eradication With Full Federal Involvement

It is likely that malathion will be used most often under the preferred alternative; methyl parathion may be used when it is economically or environmentally sound. The number of insecticidal treatments applied to infested acreage each season generally ranges from 4 to 11 during the program. Individual fields with exceptionally high numbers of weevils may receive up to 25 treatments. Boll weevil counts that would trigger a treatment would be similar to those used in the current program area: two per field during the pinhead-square stage and five per field after the cotton blooms.

The proposed program (table 2-6), which would last an estimated 3½ years, would begin with a "modified" diapause treatment schedule consisting of five to seven applications of malathion or methyl parathion during the highest boll weevil movement period (September through October), with a possible treatment in November, depending on the severity of infestation and the dates of harvest and killing frost. The following June, year 2, two to four applications of malathion or methyl parathion would be made on 50 to 60 percent of the cotton acreage, beginning at the pinhead-square stage; traps would continue to be monitored to determine when treatments are necessary. It is estimated that between 2 and 10 treatments may be required.

During June and July of the second year, one to four treatments of diflubenzuron could also be used. In the fall of year 2, 6 to 11 diapause treatments would be applied to 50 to 60 percent of the acreage, depending on the remaining boll weevil populations. Two to four treatments on approximately 10 to 20 percent of the cotton acreage would be applied during the second spring, with trap monitoring continuing throughout the season to determine when additional treatments would be needed. Diflubenzuron could again be used during June and July. The final fall diapause treatments would consist of 6 to 11 applications on an estimated 40 percent or less of the cotton acreage. After 3 years of the control program, post-eradication

Table 2-6. **Pesticide Application Schedule for Proposed Expansion of the Boll Weevil Eradication Program**

Year	Central Alabama		Northern Alabama	
	Average schedule	Maximum schedule	Average schedule	Maximum schedule
		Malathion or Methyl Parathion		
First year:				
September	2	4	—	2
October	3	3	—	3
November	—	1	—	—
Second year:				
June	3	4	3	4
July	1	5	—	5
August	1	5	—	5
September	3	5	4	5
October	2	4	3	4
November	1	2	1	2
Third year:				
June	3	4	3	4
July	1	5	—	5
August	1	5	—	5
September	3	5	4	5
October	2	4	3	4
November	1	2	1	2
		Diflubenzuron		
Second year:				
June	2	3	2	3
July	—	1	—	1
Third year:				
June	2	3	2	3
July	—	1	—	1

monitoring would continue. If boll weevils are detected, localized treatments would be applied.

When the control program progresses to northern Alabama, diapause treatments may be eliminated the first fall because the colder winter temperatures contribute to higher winter weevil mortality than in the south and central regions of the State, and the larger cotton fields in the northern Alabama program area have fewer surrounding trees, which reduce weevil overwintering sites. In the spring, the program would begin with two to four applications on an estimated 30 to 40 percent of the cotton acreage. The rest of the northern program is likely to follow the same schedule as the central program area.

The Standard Operating Procedures adhered to in the current program area, which would also be implemented in the proposed program in central and northern Alabama, are listed in table 2-7; a summary of the impacts of the program implementation is presented in table 2-8.

No Action

If the grower referendums are not held or do not pass and the program does not progress to central and northern Alabama, an eradication buffer zone would be implemented with sufficient spot treatments and monitoring to protect the 21 counties in the current program from infested counties in the rest of the State. APHIS would neither fund nor participate in any program to control boll weevils in those regions of the State, and the current grower practices described earlier in this chapter would be expected to continue, as would the cultural treatment methods of fairly uniform planting dates and stalk destruction. Growers would continue to scout their fields for all pests and bear the entire cost of all necessary insecticide treatments. Though it may be possible to control the boll weevil and other insect pests at subeconomic levels under this alternative, it would not be possible to use a more integrated approach to pest management, that is, one using natural parasites and predators and other nonchemical controls that could be used if the boll weevil were eliminated. It is likely that present levels of insecticide applications will continue to be required for economic cotton production.

The analysis of impacts presented in chapter 4 is based on a comparison of the possible effects from implementing the National Boll Weevil Cooperative Control Program in central and northern Alabama to the current agricultural environment of cotton production as it is described under the no action alternative.

Mitigation

Mitigation measures are provided in table 2-2 of the EIS. In addition to those measures described in the table, azinphos-methyl will not be used in Alabama.

(The section entitled "Limitations of the Analysis" has been moved to chapter 2 of the EIS.)

Table 2-7. Standard Operating Procedures

All Control Methods

1. All applicable Federal, State, and local environmental laws and regulations will be followed during boll weevil control operations.

2. Sensitive areas (water bodies, parks, occupied dwellings such as homes, schools, churches, hospitals, and recreation areas) that may be in or adjacent to cotton fields will be identified. The program will be adjusted accordingly to ensure that these areas are not negatively impacted.

3. Only fields meeting the program criteria will be treated.

4. All program personnel will be instructed in the use of equipment and materials and on procedures. Field supervisors will emphasize these procedures and monitor workers.

Chemical Control Methods

Aerial Applications

1. All materials will be applied in strict accordance with EPA- and State-approved label instructions.

2. Aircraft, dispersal equipment, and pilots that do not meet all contract requirements will not be allowed to operate.

3. All USDA–APHIS-PPQ employees who plan, supervise, recommend, or perform pesticide treatments must be certified under the APHIS certification plan. They also are required to know and meet any additional requirements or qualifications of the State in which they perform duties involving pesticide use.

4. Unprotected workers will be advised of the respective reentry periods following cotton field treatment.

5. All APHIS field personnel will have baseline cholinesterase tests before the first application and each spring and fall thereafter. It is recommended that contract, State, and other non-Federal personnel also participate in this testing program.

6. The program will employ only certified aerial applicators familiar with local conditions.

7. To minimize drift and volatilization, application will not be made when any of the following conditions exist in the spray area: wind velocity exceeds 10 mph (or less if required by State law); rain is falling or is imminent; weather is foggy; air turbulence could seriously affect the normal spray pattern; or temperature inversions could lead to offsite movement of spray.

8. Two-way radios will be provided to personnel who direct or coordinate field operations. Radio communication will be available to provide close coordination of all application operations.

9. Nozzle types and sizes, spray system pressure, and nozzle orientation will be as specified in the program's aerial application contract or as otherwise directed by program personnel. Some of the contract specifications required for aerial application include:

    - The use of stainless-steel nozzles to minimize wear

    - The use of diaphragm check valves in the nozzles for drip-free shutoff with minimum pressure loss

Table 2-7. Standard Operating Procedures (continued)

- Requirement for a shutoff valve between the hopper and pump to prevent the accidental loss of pesticide in the event of a pump failure

- Requirement that the end nozzles be placed no more than three-quarters of the overall wingspan to minimize the amount of spray entering the wingtip vortices. If the boom extends beyond three-quarters of the wingspan, end nozzles must be fitted with an air bleed line to prevent air entrapment in the boom and to allow positive shutoff.

Ground Applications

1. <u>Mist Blowers</u>

   - Operators will be either certified applicators or will be in constant radio contact with certified applicators.

   - Units will be operated from closed truck cabs, with operators using recirculated air.

2. <u>High-Clearance Machines</u>

   - Operators will be either certified applicators or will be in constant radio contact with certified applicators.

Table 2-8. Summary of Potential Environmental Impacts by Control Method

Resource element	Stalk destruction	Malathion	Diflubenzuron[a]	Methyl parathion
Geology and topography	No impact.	No impact.	No impact.	No impact.
Climate	No impact.	No impact.	No impact.	No impact.
Soils	No impact.	Short-term reduction in some soil insects and arachnids.	No impact.	No impact.
Vegetation[a]	Indirect impact on adjacent crops by driving non host-specific pests into them.	Slightly phytotoxic to some vegetation. Indirect impact on plant reproduction because of some loss of pollinators.	No impact.	Indirect impact on plant reproduction because of some loss of pollinators.
Nontarget terrestrial species[b]	No impact.	Generally safe for use with respect to terrestrial species except for insects such as the honey bee.	Safe for terrestrial wildlife; not likely to affect bees.	Safe under normal circumstances of exposure, but would affect animals that are directly sprayed and feed exclusively on insecticide-contaminated food.
Nontarget aquatic species[b]	No impact.	Would likely affect bluegills, painted turtles, walleyes, and invertebrates if farm ponds or streams are contaminated from drift or runoff.	Would likely affect some aquatic invertebrate species.	Not likely to affect fish, clams, aquatic reptiles, or amphibians. Some aquatic invertebrates may be at risk.
Water quality	No impact.	Possible short-term impacts in farm ponds and small streams.	Possible short-term impacts in farm ponds and small streams.	Possible short-term impacts in farm ponds and small streams.

Table 2-8. Summary of Potential Environmental Impacts by Control Method (continued)

Resource element	Stalk destruction	Malathion	Diflubenzuron[a]	Methyl parathion
Human health and safety—public	No impact.	No risk from typical exposure. No reproductive risk. Moderate risk of systemic effects as a result of direct spray, drinking 2 liters of contaminated water, or eating directly sprayed legumes. Cancer risk less than 1 in 1 million.	No risk from typical exposure. Risk from consuming fish from a pond that received spray drift in extreme scenario. Cancer risk less than 1 in 1 million.	Risk from consuming venison from a deer that was exposed to spray drift and consumed contaminated diet items. Risk to those exposed to drift within 100 ft of a cotton field or from eating contaminated berries or legumes near the site. Risks from consuming fish from a pond that received spray drift. Risk of systemic and reproductive effects from direct spray, drinking contaminated water, or eating berries or legumes that were directly sprayed.

Table 2-8. Summary of Potential Environmental Impacts by Control Method (continued)

Resource element	Stalk destruction	Malathion	Diflubenzuron[a]	Methyl parathion
Human health and safety—worker	No impact.	Risk to observer/EM team and hiboy and mist blower operators in routine applications. Risk of systemic effects to observer/EM team, hiboy and mist blower operators, and risk of reproductive effects to observer/EM team and hiboy and mist blower operators from extreme exposure. Significant systemic and reproductive risks from accidents. Cancer risk to all workers is greater than 1 in 1 million.	Risk to hiboy and mist blower operators in routine applications. Systemic and reproductive risks to hiboy and mist blower operators from extreme exposure. Systemic and reproductive risks from accidents. Cancer risk to all workers is greater than 1 in 1 million.	Risk to mixer/loaders, observers/EM team, and hiboy and mist blower operators in routine applications. Risk to pilots in routine applications. Reproductive risk to mixer/loader and observer/EM team, and to hiboy and mist blower operators from routine exposure. Systemic and reproductive risks to workers under exteme and accident scenarios.

[a] Reproductive risks for diflubenzuron are uncertain; the NOEL used is the highest dose tested.
[b] Impacts on individual endangered, threatened, or proposed plant, wildlife, and aquatic species are assessed separately. Full assessment and protection measures are presented in appendix B.

Section 3

Affected Environment

Overview

The parts of Alabama that could be affected by implementing the National Boll Weevil Cooperative Control Program in central and northern Alabama include cotton fields as well as adjacent nonagricultural areas.

Chapter 3 describes the environment of all Cotton Belt States. The information presented in this section is intended to supplement the general information for Alabama included in descriptions of the coastal subarea of the Southeast program area.

The natural and human environments vary across Alabama. Physical characteristics, such as topography and soils, and biological parameters, such as the presence of endangered, threatened, and proposed species differ from one area of the State to another. This section describes the potentially affected environment in Alabama for the following resource elements: geology and topography, climate, soils, vegetation, nontarget species, water resources, human populations, economics, cultural and visual resources, air quality, and noise.

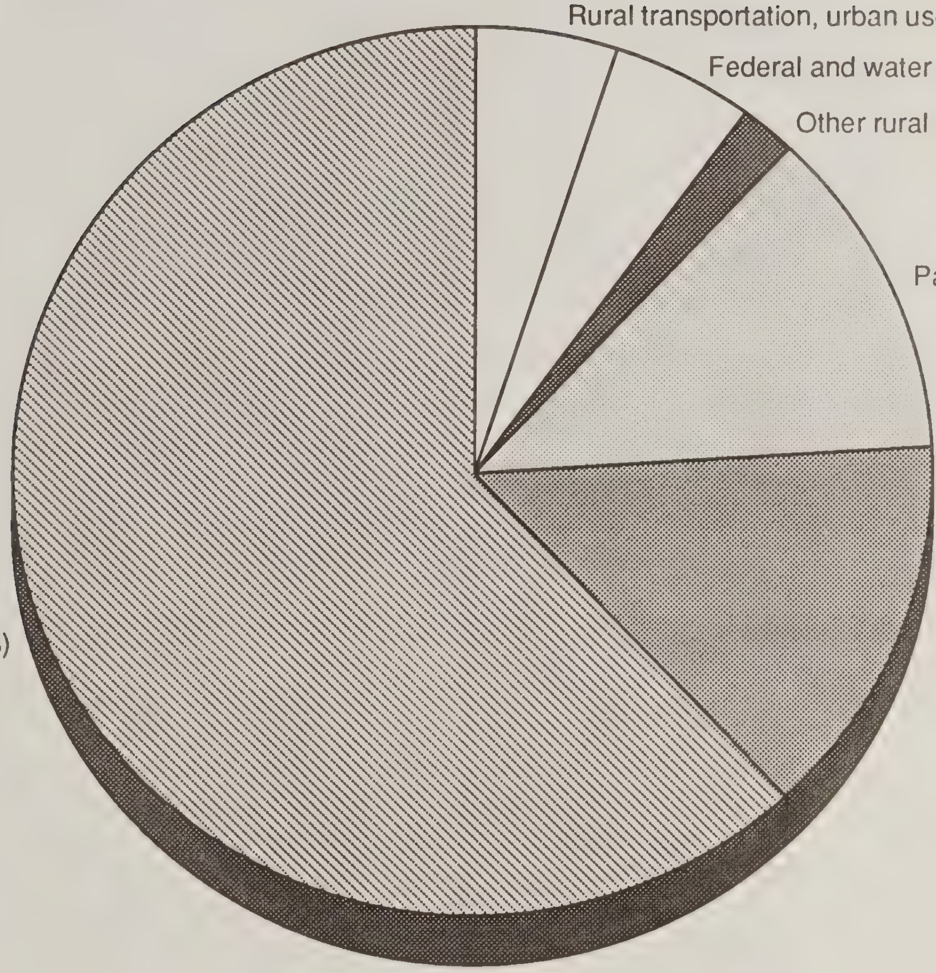
Alabama, located in the Southeastern United States, is bounded on the north by Tennessee, on the east by Georgia, on the south by Florida and the Gulf of Mexico, and on the west by Mississippi (fig. 3-1). Alabama's roughly rectangular area of 33.1 million acres (1.7 percent of the area of the continental United States) comprises 32.5 million acres of land (98 percent of the State's total area) and 0.6 million square miles of water (2 percent) (USDC, 1990). Rural areas supporting forests and agriculture constitute approximately 90 percent of the total land area of Alabama, or about 27 million acres (USDC, 1990).

Before settlement, Alabama was covered with primeval pine and hardwood forests and constituted one of the world's greatest timber regions (Walker, 1975). Despite intensive logging, 21 million acres of forest land still occupy 62 percent of the State (fig. 3-2) (USDC, 1990). Many State parks, National Forest Recreation Areas, game management areas, and wildlife refuges are located in these forested areas (Alabama Department of Economic and Community Affairs, 1989). Over time, parts of the forest land have been cleared for cropland, pastureland, transportation routes, and urban development (USDC, 1990).

The greatest proportion of agricultural lands are in the northern, west central, and southeastern areas of the State. These agricultural lands support a variety of livestock, dairy, poultry, and field crops (ADECA, 1989). Cropland represents 14 percent of the State's area (4.5 million acres); approximately 7 percent of this cropland is planted with cotton. Other principal field crops include soybeans, winter wheat, corn, peanuts, and sorghum. Hay, oats, peaches, pecans, and sweet potatoes are also grown (ADAI, 1990).

Figure 3-1. Location of Alabama

Figure 3-2. Land Uses in Alabama



Note: Shaded portions represent rural areas (90% of Alabama).

Source: USDC, 1990.

Minerals found in the State include bauxite, asphalt, clay, mica, marble, salt, and petroleum (Hammond, 1981). Deposits of coal, iron ore, and limestone—the ingredients for making steel—led to the development of iron and steel manufacturing in the eastern part of Alabama (Walker, 1975). The manufacture of aluminum, chemicals, fertilizers, metal and rubber products, and textiles are the predominant industries in northern Alabama. In southern Alabama, industries primarily manufacture metal products, machinery, cement, paper products, and chemicals (Hammond, 1981).

Commercial fishing is also an important activity in southern Alabama; crabs, shrimp, oysters, and mullet are the main species caught in the Gulf of Mexico (USDC, 1990). Ponds throughout the State support catfish hatcheries. Alabama's lakes and rivers are used for commercial and recreational fishing, as well as for boating and other water sports.

Geology and Topography

Alabama can be divided into four physiographic regions: the Appalachian Plateau, ridge and valley, Piedmont, and coastal plain (fig. 3-3). The State is mountainous in the northeast, where spurs of the Appalachian Mountain range enter from Tennessee. From an elevation of 1,800 feet, the land drops sharply northwest to the Tennessee Valley and then slopes gradually toward the south until it reaches sea level. Westward, the land shelves in a gradually diminishing range of hills (Walker, 1975). The average State elevation is 250 to 500 feet above sea level (Nomad, 1986).

Appalachian Plateau (Cumberland Plateau)

The Appalachian Plateau, known as the Cumberland Plateau in Alabama, Tennessee, and Kentucky, is underlain by horizontal sediments of the upper Paleozoic Age. The Tennessee Valley (in the northern part of this region) is a relatively level section of about 4,900 square miles on both sides of the Tennessee River. The naturally productive soils in this valley have made it Alabama's primary cotton-producing area (Walker, 1975). Elevations in the Appalachian Plateau range from approximately 1,000 feet in the floodplain of the Tennessee River to 700 feet in the southern part of the region.

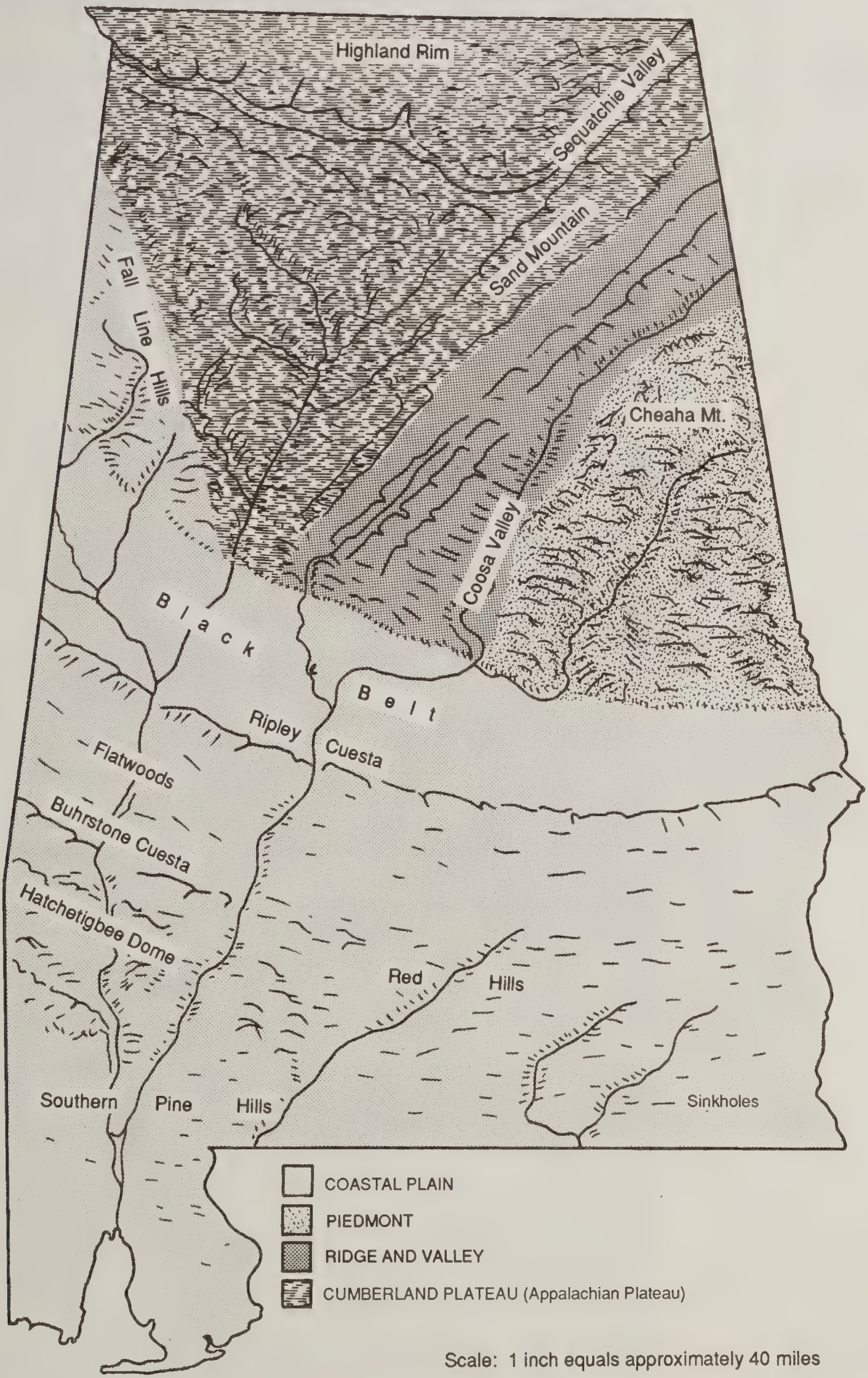
Ridge and Valley

The ridge and valley region in Alabama, underlain by Paleozoic sediments, consists of a series of parallel ridges and valleys running northeast to southwest. The narrow ridges are a continuation of the Appalachian Mountain chain, which enters the State in the northeast corner. The Coosa Valley is more rugged and less suited to agriculture than the Tennessee Valley (Walker, 1975). Elevations range from 1,200 to 1,800 feet along the ridges and mountains to 500 feet in the wide lowland area drained by the Coosa River.

Piedmont

The Piedmont region is underlain by igneous and metamorphic rocks of the Precambrian and Paleozoic Ages. Most of the region is composed of small rolling hills at elevations of 700 to 1,000 feet, with streams occupying the valleys (Lineback and Traylor, 1973). Mount Cheaha, the highest peak in the State, is located in the Talladega Hills, where elevations range from 900 to 2,407 feet. These areas are too steeply

Figure 3-3. Physiographic Regions of Alabama



Source: Adopted from Erwin Ratsz;
as cited in Lineback and Taylor, 1973.

sloping for agriculture; most rolling areas are used as pasture or forest (Mitchell and Meetze, 1986).

Coastal Plain

The coastal plain is underlain by relatively unconsolidated Mesozoic and Cenozoic sedimentary rock, which dips toward the Gulf of Mexico. Chalk of the Cretaceous Age underlies the Black Belt, a strip of rolling prairie land with rich black soil. This 4,300-square-mile area was once the chief cotton-growing area of Alabama, but it is now used primarily for soybeans, timber production, and pasture (Mitchell and Meetze, 1986). Below the Black Belt, a low line of hills (cuestas) are separated by lowland areas. Elevations range from 200 to 300 feet in most of the plain to sea level at the coast. The coastal plain is the largest agricultural area in Alabama, although it does not support the highest cotton production in the State (Walker, 1975).

The northern border of the coastal plains marks the contact between the crystalline rocks of the Piedmont and the sedimentary rocks of the coastal plains. This irregular boundary is referred to as the fall line of the Atlantic States.

Climate

Alabama's climate is humid and subtropical, with precipitation distributed throughout the year. Summers are hot and humid, with little variation in temperature from day to day. The winters are relatively mild, and severely cold or snowy periods seldom occur. Temperatures below zero are rare, occurring on an average only once in 6 to 7 years (Ruffner, 1978). Precipitation is heaviest along the gulf coast during summer and heaviest in the northern sections of the State during winter. Thunderstorms are common during the summer, and tropical hurricanes occasionally reach the gulf region (Ruffner, 1978).

Temperatures

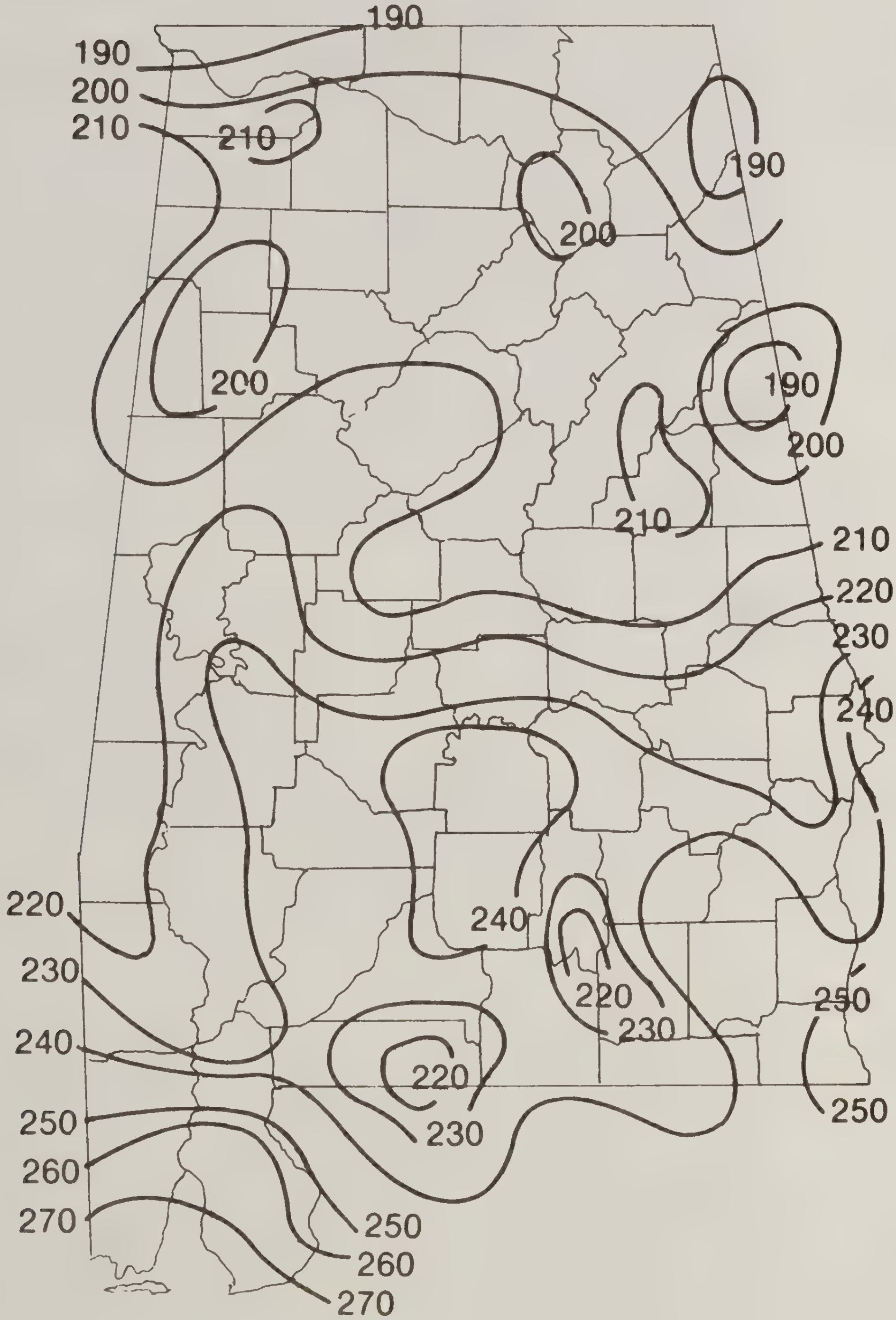
During the winter months northern Alabama is cooler than the southern part of the State. Temperatures during January, the coldest month, average 40°F in the north and 50°F in central and southern Alabama (ADECA, 1989). The first killing frost generally occurs at the end of October in the north, the beginning of November in the central and south, and the beginning of December along the gulf coast. Temperatures below freezing usually last less than 48 hours (Lineback and Traylor, 1973).

During July, the hottest month, daily temperatures average 80°F throughout the State (ADECA, 1989). The last killing frost in the spring usually occurs by the beginning of April in the northern part of the State, the end of March in the central part, mid-March in the south, and mid-February along the gulf coast. The date of the last killing frost marks the beginning of the growing season; because winter frosts end earlier in the south, that area has a longer growing season. The growing season ranges from 190 to 210 days in the north, 200 to 240 days in central Alabama, and from 220 to 270 days in the south (fig. 3-4).

Precipitation

Precipitation varies slightly geographically. The mean annual precipitation for selected regions of the State is 54 inches in the north and

Figure 3-4. Average Length of Growing Season in Alabama (days)



Source: ADECA, 1989.

central regions (Appalachian Mountains and upper plains), 56 inches in the south (coastal plains), and 65 inches along the gulf. However, the timing of the precipitation varies considerably among the different areas. The greatest monthly levels of precipitation for north and central Alabama occur in March, while the south receives the most monthly precipitation in July (USDC, 1968).

During the hot summer months, most precipitation results from afternoon thundershowers (Ruffner, 1978). These summer thundershowers provide sufficient moisture for crops (Lineback and Traylor, 1973). Except for the coastal region, where late night and early morning thundershowers persist until mid-September, the frequency of thundershowers decreases during the late summer months, and dry, sunny conditions usually prevail in September and October. Tropical hurricanes reach the State on an average of 1 in 7 years between July and November, often causing heavy rains and high winds (Ruffner, 1978).

Precipitation in the State is almost always in the form of rain, and the annual average snowfall is 3 inches in winter. The north has 2 to 3 days each winter with measurable snowfall; the central and south have 1 day every 2 to 3 years (Lineback and Traylor, 1973).

Soils

Variations in topography, climate, and age affect soil characteristics. For example, the well-drained, moderate slopes in humid subtropical areas such as Alabama contribute to the formation of mature soils with well-developed topsoil. These soils are well suited for agriculture (Lineback and Traylor, 1973).

Four groups of soil orders are represented in the State: ultisols, inceptisols, entisols, and vertisols. The characteristics of these soil orders are provided in chapter 3. The State may be further divided into seven regions, which display similar soil characteristics (fig. 3-5). The general characteristics of each region are described in the following sections.

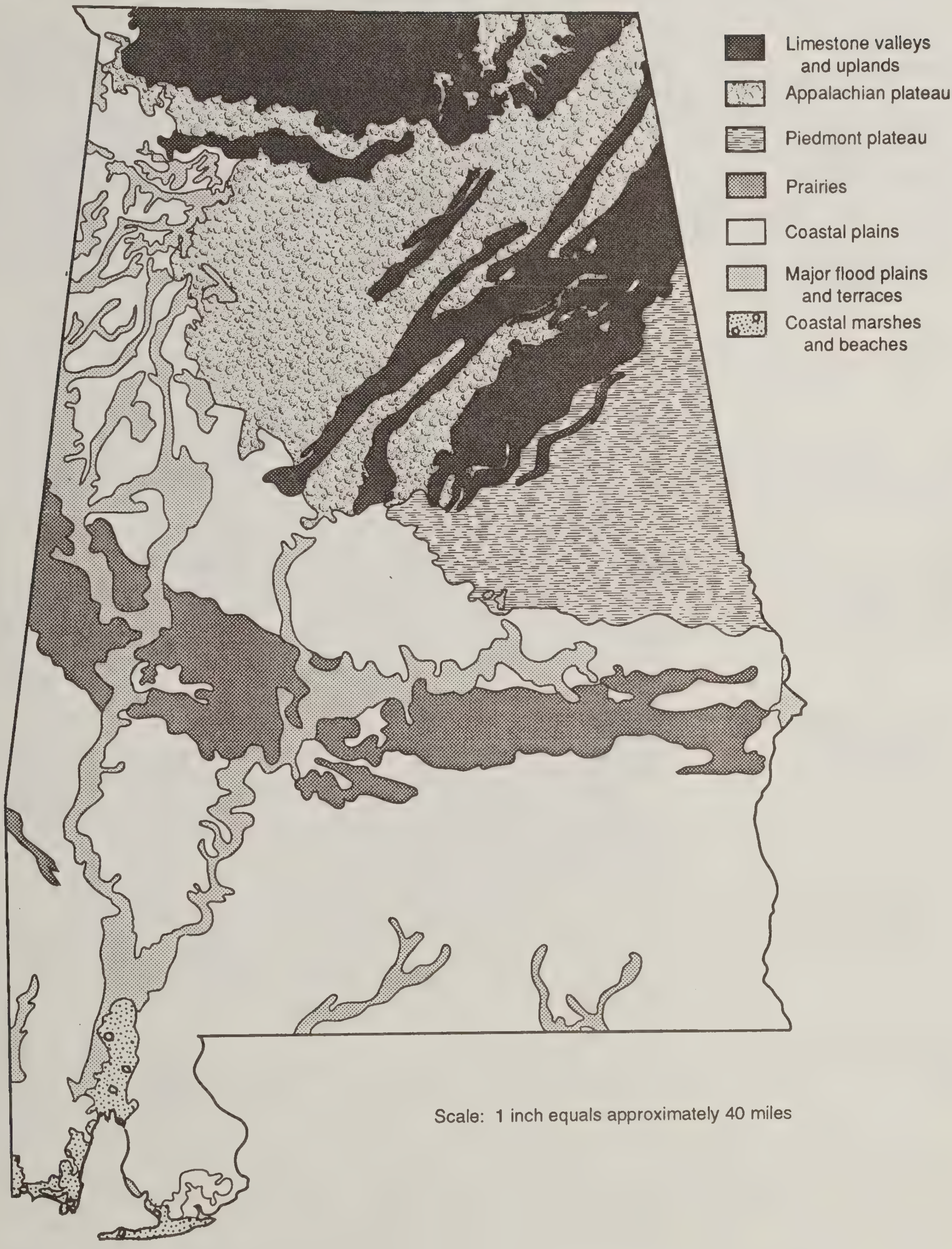
Limestone Valleys and Uplands

Soils in the limestone valleys have been formed from limestone that has been extensively eroded over time. The Tennessee and Coosa River Valley soils are representative of this region and are characterized by red clay subsoils and surface soils composed of silt loam. Soils in the uplands were primarily derived from the erosion of cherty (flinty) limestone. These soils, which typically have a cherty loam and cherty clayey subsoil and cherty silt loam surface layers, are used for row crops, such as cotton and soybeans. Much of the uplands is pasture or forest land.

Appalachian Plateau

Most of the soils in the Appalachian Plateau are derived from sandstone or shale. These soils have either a loamy or clayey subsoil and a silt-loam surface layer. The more level areas of the Plateau are dominated by soils formed from the erosion of sandstone. These areas are characterized by loamy subsoils and fine sandy loam surface layers.

Figure 3-5. Soil Areas of Alabama



Source: Mitchell and Meetze, 1986.

Corn, soybeans, potatoes, and tomatoes are the main crops of the Appalachian Plateau. Poultry is also important in this area.

Piedmont Plateau

Most of the soils in the Piedmont region are derived from schists and are characterized by red clayey subsoils and sandy loam and clay loam surface layers. The rolling areas were once cultivated but are now pasture or forest land.

Coastal Plain

The coastal plain is characterized by either loamy or clayey subsoils and sandy loam, loam, sand, or loamy sand surface layers. Most of the soils in this region are derived from marine and river sediments eroded from the Appalachian and Piedmont Plateaus. Major crops are corn, peanuts, soybeans, and horticultural crops. Timber products and hogs are also prevalent.

Prairies

These soils were derived from alkaline, Selma, chalk, or acid marine clays. Most soils in this region are acidic, poorly drained, and contain a large percentage of montmorillonitic clays, which shrink and crack when dry and swell when wet. This area of central and western Alabama is known as the "Black Belt" because of the dark surface colors of many of the soils. Soybeans are the principal crop. Most of these soils are used for timber production and pasture.

Major Floodplains and Terraces

The soils in this region are found along streams and river terraces. They are derived from alluvium deposited by streams during their normal flow and when excessive precipitation causes flooding. A typical area consists of cultivated crops on the level terraces and bottom land hardwood forests on the floodplain of streams.

Coastal Marshes and Beaches

The soils in this region are found only on nearly level bottom lands and tidal flats along the Mobile River, Mobile Bay, and the Gulf of Mexico. The soils may be broken down into four types—muck surface layers over sand; mucky sandy, clay loam surfaces over sandy loam subsoil; silty clay loam over clay; and sand that overlies other types of sand (Mitchell and Meetze, 1986).

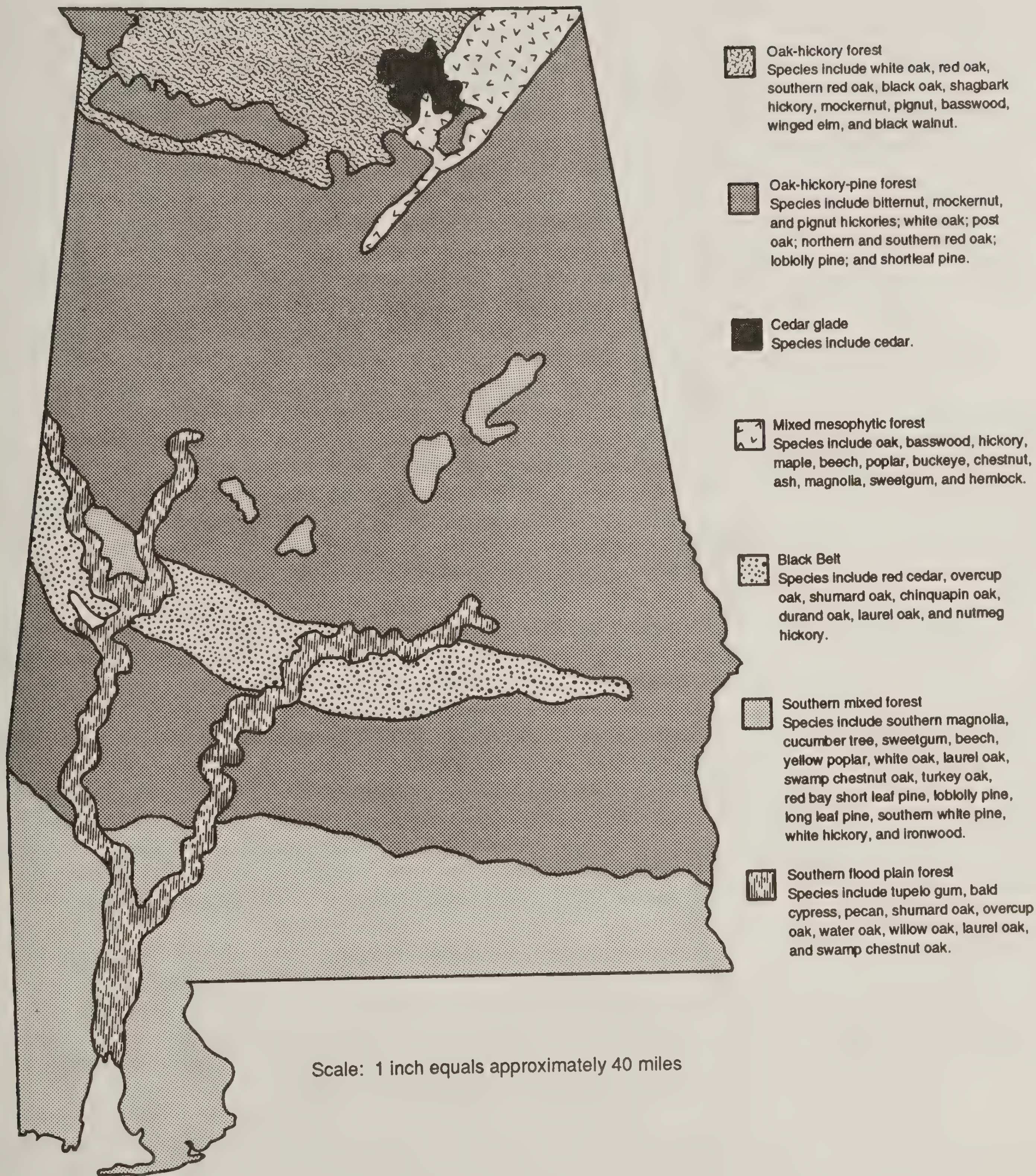
Vegetation

Alabama's natural vegetation changes with the region, elevation, rainfall, and soil type. Throughout Alabama, the natural, undisturbed vegetation type is forest. Types of forests found in Alabama include the oak-hickory forest, the mixed mesophytic forest, the oak-hickory-pine, and the southeastern mixed forest (fig. 3-6).

Plant Communities

In the extreme north central and northwestern areas of the State, the oak-hickory forest is the dominant plant community. This forest type, which also covers much of the central midwestern United States, is characteristic of relatively dry sites. The dominant tree species in this forest are white oak, red oak, southern red oak, black oak, shagbark hickory, mockernut, and pignut. Basswood, winged elm, and black walnut also are commonly found in the oak-hickory community (Lineback and Traylor, 1973).

Figure 3-6. Alabama Vegetation Types



Source: A.W. Kuchler, *The National Atlas of the United States of America* as cited in Lineback and Taylor, 1973.

In the northeastern corner of Alabama, adjacent to the oak-hickory forest, the southern terminus of the Appalachian highlands forms moist, cool ravines where the mixed mesophytic forest is the dominant plant community. Several different species of oak, basswood, hickory, maple, beech, poplar, buckeye, chestnut, ash, magnolia, sweetgum, and hemlock are the dominant tree species in this forest type. In spring, a thick layer of herbaceous plants covers the ground. Many of these species have showy flowers, such as lady's slippers, trilliums, and violets. Flowering of this herbaceous layer is finished by the time the leaves come out on the upper-canopy deciduous trees (Sutton and Sutton, 1985). A third forest type, the cedar glades, is also restricted to northern Alabama. Scattered between the oak-hickory and mixed mesophytic communities are areas where extremely shallow soil covers limestone formations. The red cedar is the most common species and sometimes the only tree species found in these areas. In addition, many herbaceous species, including some endangered species, and various flowering shrubs are found in the cedar glades (Lineback and Traylor, 1973).

The oak-hickory-pine forest community is the most common forest community in Alabama, extending from the oak-hickory and mixed mesophytic forests in the north through much of the central areas of the State. The dominant tree species in this mixed pine-hardwood community include bitternut, mockernut, and pignut hickories, white oak, post oak, northern and southern red oak, and loblolly and shortleaf pine. Fire and other disturbances play a large part in maintaining the oak-hickory-pine forest. Undisturbed forest areas contain primarily hardwood species, while pure stands of pine develop in disturbed areas. In the absence of further disturbances, the stands of pine are ultimately replaced by a more mixed forest in which single or small clusters of pines are found among the dominant hardwood species. Elevation and moisture levels also affect species distribution in the oak-hickory-pine forest. On dry ridges, Virginia pine and scarlet oak are the dominant species, while yellow poplar, shumard oak, willow oak, live oak, and bay magnolia commonly occur in wetter areas (Lineback and Traylor, 1973). Understory species include dogwood; viburnum; American beautyberry; and grasses, such as bluestem and panicum (Bailey, 1980).

In the extreme southern end of Alabama, the southern mixed forest is the principal vegetation community. This zone contains a mixture of broadleaf deciduous species, evergreens, and various pine species, including southern magnolia, cucumber tree, sweetgum, beech, yellow poplar, white oak, laurel oak, swamp chestnut oak, turkey oak, red bay, shortleaf, loblolly, longleaf, southern white, white hickory, and ironwood. Large areas in this community have predominantly pine forests, but these are in excessively dry or wet habitats, or in areas of second growth occurring after deforestation or fire. The climax vegetation type in this area is evergreen-oak and magnolia forest (Bailey, 1980). In sandy areas near the coast, the dense forest thins out. This vegetation subzone, called the pine-oak savanna, also contains a thick understory of shrubs (Lineback and Traylor, 1973).

Two other notable vegetation communities exist in Alabama—the Black Belt and the southern floodplain forest. The Black Belt is a narrow band approximately 20 miles wide that extends across south-central Alabama from the Montgomery area through Sumter County and into Mississippi. The belt coincides with an outcrop of limestone, known as the Selma Chalk, which weathers to a dark, heavy soil. In areas where this chalk soil is deep, the forest contains vegetation similar to the types found in adjacent regions, as well as species found predominantly on limestone soils, including red cedar, overcup oak, shumard oak, chinquapin oak, durand oak, laurel oak, and nutmeg hickory. On thin or disturbed soils, the forest thins out and is replaced by open, prairie-like plant communities. The prairie species commonly found in the thin-soiled areas of the belt are prairie sunflower, prairie cornflower, prairie rose, Cherokee sedge, tuberous milkweed, Torrey's rush, cut-leaf verbena, and big bluestem grass (Lineback and Traylor, 1973).

The southern floodplain forest occurs along the middle and lower reaches of the Warrior, Tombigbee, Alabama, and Mobile Rivers. Although these rivers traverse other vegetation communities in the State, a distinct forest ecosystem parallels the rivers and is dominated by tupelo gum, bald cypress, pecan, and various oak species, including shumard oak, overcup oak, water oak, willow oak, laurel oak, and swamp chestnut oak. Additionally, swamp privet, red bay, water elm, American elm, cabbage palm, sugarberry, and rattan vine are found in the floodplain forest (Lineback and Traylor, 1973).

Endangered and Threatened Plants

Twelve federally listed endangered or threatened plant species occur in Alabama's cotton-producing counties. Attachment B contains additional information about these species and their habitats.

Nontarget Species

The diversity of habitats within Alabama supports many different small mammals, birds, reptiles, and amphibians. Cotton fields are often noncontiguous plots of land with dispersed forested areas, or are adjacent to rivers, streams, and floodplains that support a diversity of terrestrial and aquatic life. A limited number of species have made suitable habitats within these often small (less than 30 acre) plots located near rural houses, while other species may occasionally enter the fields to forage or prey on insects. The following section describes the representative wildlife commonly found in agricultural areas in Alabama. Information for the following discussion and for attachment A was compiled from several sources, including the Audubon Society Nature Guide (Sutton and Sutton, 1985) and other wildlife and endangered species books (Burt and Grossenheider, 1964; Conant, 1958; USDOI, 1980; Mount, 1986; USDA, 1975; Snedigar, 1962).

Terrestrial Vertebrates

Many small mammals, such as the whitetailed deer (*Odocoileus virginianus*), the raccoon (*Procyon lotor*), the opossum (*Didelphis marsupialis*), the red fox (*Vulpes fulva*), and the grey fox (*Uroeyon cinereoargenteus*) are often found in and around Alabama's farming areas. Deer and racoons have similar habitats and feed on fruits and acorns of naturally occurring plants, although they will browse among

cotton plants if the area is overpopulated and food is scarce (Davis, 1979; Johnson, 1970). The swamp rabbit (*Sylvilagus aquaticus*), river otter (*Lutra canadensis*), and beaver (*Castor canadensis*) can be found near bodies of water and will sometimes venture into fields in search of food. Many different insectivorous bat, mouse, and shrew species are also present in farming areas.

Many insectivorous bird species are found in the cotton-producing areas, including the American crow (*Corvus brachyrhynchos*), the mourning dove (*Zenaida macroura*), the American robin (*Turdus migratorius*), the field sparrow (*Spizella pusilla*), and others. These areas also have a number of hawk and falcon species; several less well-known species inhabit or occasionally fly into the forests and wetlands adjacent to cotton fields. For example, numerous owl species, the yellow-throated and warbling vireo (*Vireo flavifrons* and *Vireo gilvus*), and the brown thrasher (*Toxostoma rufum*) frequent these areas to feed on insects, fish, and small mammals.

The Alabama program area also has many reptiles, such as the brown snake (*Storeria dekayi*), Eastern box turtle (*Terrapene carolina*), the king snake (*Lampropeltis getulus*), and a number of other snake, frog, and turtle species. Many of these are found in the riparian areas adjacent to cotton fields, but they may rove into the cotton fields to feed.

Domestic Animals

Livestock are an important component of the agricultural income in Alabama. Cattle, hog, chicken, and turkey farms are located throughout the State. Beef cattle, such as Aberdeen-Angus, Hereford, Shorthorn, and Santa Gertrudis, and Holstein-Friesian dairy cows are commonly raised on farms. White-Leghorn chickens and hybrids are raised for egg production, while the White Plymouth Rock chicken is a common broiler.

Dogs and cats are common farm pets throughout the program area. Rats are also found, often where large quantities of feed grains are stored on farms.

Aquatic Vertebrates

Fish

The numerous natural and artificial water bodies and wetlands throughout the cotton-producing areas contain diverse aquatic life. Several species of bass are present, as are various darter, minnow, cavefish, and shiner species. Other species present include the yellow perch (*Perca flavescens*), brook trout (*Salvelinus fontinalis*), and both the green (*Lepomis cyanellus*) and redbreast (*Lepomis auritus*) sunfish species.

Several catfish and bass species have become economically important in Alabama. Channel catfish (*Ictalurus punctatus*) and blue catfish (*Ictalurus furcatus*), as well as Florida strain largemouth bass, bluegill, shellcracker, and hybrid striped bass, are raised in fish hatcheries.

Game fish are stocked in public waters and private ponds throughout Alabama. Hatcheries in Eastaboga and Marion are the largest, producing approximately 130,000 catfish and 500,000 Florida bass annually (Turner and Cook, 1990).

Amphibians and Reptiles

Various newt, salamander, and turtle species inhabit the water bodies of the program area, such as the eastern newt (*Notophthalmus* spp.), the dusky gopher frog (*Rana areolata sevosa*), the northern cricket frog (*Acris crepitans crepitans*), the green salamander (*Aneides aeneus*), the Alabama red-bellied turtle (*Pseudemys alabamensis*), and the alligator snapping turtle (*Macroclemys temminicki*). Several species of aquatic snakes are also present in the area; the cottonmouth (*Agkistrodon* spp.) is the only indigenous poisonous snake.

Terrestrial Invertebrates

Numerous bugs, flies, crickets, ants, worms, grasshoppers, butterflies, and other invertebrates are found throughout the program area. Bees, butterflies, and other pollinators are widespread and crucial to the propagation of crops and other plant species. Honey bees (*Apis mellifera*) are especially common and are important crop pollinators.

Cotton fields are also inhabited by a large number of species of insects, spiders, mites, and other arthropods referred to collectively as the cotton arthropod complex. (Information for the following discussion of these pests and beneficial species was compiled from the Cotton Scouting Handbook (Circular ANR-409), which is published through the Alabama Cooperative Extension Service.)

Tarnished Plant Bugs

The tarnished plant bug (*Lygus lineolaris*) overwinters as an adult and usually completes one or two generations on a number of hosts, including fleabanes, wild carrot, dock, mustard, and various legumes. The migration to cotton plants occurs primarily in June, and populations peak toward the end of June as the eggs begin to hatch. Although populations usually decline naturally during July, the number of pests does not necessarily indicate how much damage will be incurred. Several other plant bugs may attack cotton and cause damage similar to that of the tarnished plant bug, including the clouded plant bug (*Neurocolpus nubilus*), the cotton fleahopper (*Pseudatomoscelis seriatus*), the rapid plant bug (*Adelphocoris rapidus*), and the four-lined plant bug (*Poecilocapsus lineatus*).

Cotton Bollworm and Tobacco Budworm

The cotton bollworm (*Heliothis zea*) and the tobacco budworm (*Heliothis virescens*) cause similar damage to cotton and are often found in the same fields; however, the tobacco budworm is more difficult to control. The tobacco budworm population peaks in June, while the late July generation is mostly bollworms.

Spider Mites

Spider mite (*Tetranychus urticae*) infestations arise near field margins, in weed clumps, around power poles, and so forth. The mites prosper in warm dry weather, and widespread infestation is usually the result of mechanical dispersion by farm equipment or windy weather, because they crawl inefficiently and do not fly. Because they have a short life cycle (about 15 days), high populations may be reached quickly. However, mites are susceptible to predation and diseases, so they are usually controlled naturally.

Thrips

Tobacco thrips (*Frankiniella fusca*), flower thrips (*F. tritici*), and others tend to be chronic problems, migrating from various wild hosts in early spring as soon as cotton emerges. Heavy thrip damage is often associated with wet, cool spring weather, but the damage usually declines as temperatures become warmer and cotton grows more vigorously. Thrips may still be present but are no longer considered harmful, and are even considered beneficial by some because they serve as prey for several predators of the bollworm and budworm. The western flower thrip (*F. occidentalis*) was first identified in southeastern Alabama in 1980 and has since spread rapidly through the State; however, its status as a pest is poorly understood. Because a generation of thrips is completed in 2 weeks, each year multiple generations are present simultaneously in Alabama.

Cotton Aphid

Winged cotton aphids (*Aphis gossypii*) enter cotton in spring or early summer to give birth to live young. They have tremendous reproductive potential and can attain huge populations in a short time if unchecked. However, they are highly vulnerable to predation and parasitism. Aphids may cause severe damage to cotton seedlings in cool weather when the reproduction and subsequent increase in natural enemies is retarded. Increases in insecticide use have also decreased populations of natural enemies and have allowed the cotton aphid to become a consistent pest in mid- and late-season cotton throughout most of Alabama.

Cutworms

The common cutworms in Alabama include the granulate (*Felitia subterranea*), variegated (*Peridroma saucia*), black (*Agrotis ipsilon*), and climbing cutworms. Cutworms come out of the soil to feed at night, doing most of their damage to cotton at the seedling stage. Damage is normally dispersed, occurring in low areas, on new ground, and in places where weed competition is heavy.

Beet Armyworm

The beet armyworm (*Spodoptera exigua*) deposits eggs on the bottom of leaves, in masses. When the larvae hatch, they feed in mass, skeletonizing the leaves near the egg mass (Alabama Cooperative Extension Service, 1991a). While the beet armyworm is mainly a foliage feeder, it has been known to feed almost exclusively on squares and blooms just before peak bloom. The beet armyworm is primarily a late-season cotton pest, but infestations along the coastal plain of Alabama have occurred as early as June and July. Since 1988, the beet armyworm has become a significant cotton pest in Alabama, increasing pest control costs up to $75 to $150 per acre in some areas. Infestations are generally associated with dry weather. The most serious recent infestation occurred in 1988, when about 10 percent of the acreage in southeastern Alabama experienced 75 to 100 percent crop losses. Although the total acreage was not as extensive as in the 1988 season, the 1990 infestation was equally as severe. In 1989, heavy rains in June helped to control the beet armyworm. Control is difficult because early season applications of any insecticides that decimate or suppress beneficial insects can severely disrupt the natural predators of the beet armyworm, resulting in even worse infestations (ACES, 1991b). Pigweeds are the preferred host of the beet armyworm (*Spodoptera exigua*), but populations may increase to damaging levels in cotton late in the season.

Other Pests

Cabbage loopers (*Trichoplusia ni*) seldom require chemical control because of the large number of natural controls, such as viral disease (evidenced by the black, slimy remains of larvae hanging from leaves). Populations of whiteflies (*Trialeurodes abutilonea*) peak late in the cotton season; a generation requires 2 to 3 weeks to develop. The cotton leafworm (*Alabama agrillacea*) is a voracious leaf feeder and is usually found in largest numbers late in the season. This insect overwinters in the tropics and must migrate each year.

Beneficial Species

Approximately 600 different beneficial species of insects may be found in cotton, but only a few are found frequently. Beneficial species may be predators that feed on a pest for a single meal, or parasites that make their home in the body of another insect from which they get food for at least one stage of their life. These beneficial species include green lacewings (*Chrysopa* spp.); brown lacewings (*Hemerobius* spp.); minute pirate bugs (*Orius* spp.); big-eyed bugs (*Geocoris* spp.); damsel bugs (*Nabis* spp.); lady beetles (*Coccinella* and *Hippodamia* spp.); hover flies (*Syrphus* spp.); and certain predaceous thrips (*Thysanopterae*), mites (*Acarinae*), and spiders (*Araneidae*).

Aquatic Invertebrates

Diverse invertebrate aquatic organisms inhabit the water bodies within the Alabama program area. A variety of worms (*Oligochaeta*), leeches

(*Hirudinea*), snails (*Gastropoda*), mussels (*Pelecypoda*), and shrimp (*Crustacea*) populate the inland waters of Alabama. These organisms feed on detritus, plants, and smaller invertebrates, such as copepods (*Calanoida* spp.), rotifers (*Keratell* spp.), and cladocerans (*Daphnia* spp.). These small invertebrates are near the bottom of the food chain, and thus directly or indirectly support all larger aquatic life. Many of these larger species are economically important to Alabama, such as shrimp harvested for commercial or research purposes and freshwater crayfish collected for human consumption.

The life cycles of several insects, such as the mayfly (*Ephemeroptera*), the dragonfly (*Odonata*), and the stonefly (*Plecoptera*) are closely linked to water. Aquatic larval and nymph forms are an important food source for many freshwater fish. A number of flies (for example, *Diptera*) and mosquitoes (*Culicidae*) are also dependent on water. Truly aquatic insect species that may be found in Alabama include giant waterbugs (*Belostomidae*), water scorpions (*Nepidae*), and water beetles (*Haliplidae*) (Klots, 1966; Borror and White, 1970).

Endangered, Threatened, and Proposed Vertebrates and Invertebrates

Thirty-four federally listed endangered, threatened, or proposed terrestrial and aquatic species occur in Alabama's cotton-producing counties. Attachment B describes each individual species and its habitat.

Water

Alabama relies heavily on more than 40,600 miles of rivers and streams for public and industrial water supplies, navigation, agriculture, industry, hydropower generation, and recreation. Other surface water resources in the State include 43 publicly owned lakes, reservoirs, and ponds covering approximately 504,336 acres; freshwater wetlands covering approximately 400,000 acres; and tidal wetlands covering 2,600,000 acres (Alabama Department of Environmental Management, 1990). Groundwater is used extensively in the State for public water supply, as well as irrigation, livestock, and industrial-commercial supplies.

Surface Water

In 1985 approximately 96 percent of all water withdrawals in Alabama came from surface water supplies, with the remaining 4 percent coming from groundwater. Hydroelectric power generation accounted for 80 percent of the total withdrawals (Baker and Mooty, 1987). Approximately 45 percent of the population of Alabama relies on surface water for its municipal freshwater needs (USGS, 1986).

Lakes and reservoirs, created primarily by dams, are found throughout Alabama. Several of these lakes lie in areas of significant cotton production. Lake Eufaula, in Henry and Barbour Counties, is located in the south Alabama program area. In the central program area two reservoirs are located near cotton production: Miller's Ferry Reservoir, in Dallas and Wilcox Counties, and Lake Martin, in Elmore, Coosa, and Tallapoosa Counties. In north Alabama, the reservoirs created by damming the Tennessee River (Pickwick, Wheeler, Guntersville, and

Wilson Lakes) are located in the cotton-producing Counties of Lauderdale, Colbert, Limestone, Lawrence, Morgan, Madison, Jackson, De Kalb, and Marshall.

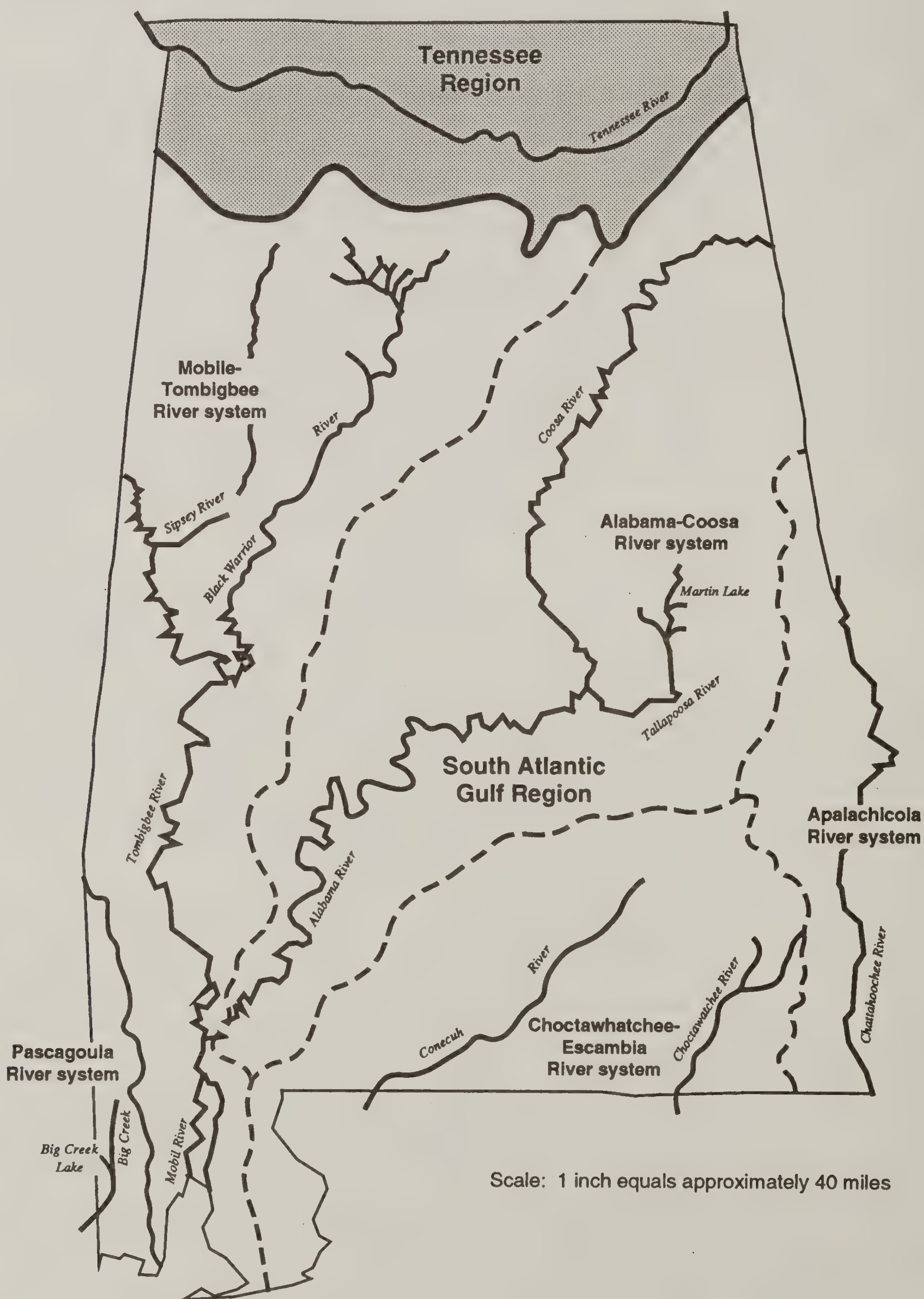
Alabama is physically situated in two water-resource regions: the Tennessee Region and the South Atlantic Gulf Region (fig. 3-7). The northernmost 7,500 square miles of the State are in the Tennessee Region and drain to the Tennessee River system, which eventually feeds into the Mississippi River (U.S. Army Corps of Engineers, 1981). The rest of the State, approximately 44,200 square miles, makes up the South Atlantic Gulf Region. This region drains to the Gulf of Mexico, either by way of the Mobile River system or the series of coastal rivers and tributaries. The South Atlantic Gulf Region is divided into five subregions within the State: the Alabama-Coosa River system, the Mobile-Tombigbee River system, the Choctawhatchee-Escambia River system, the Apalachicola River system, and the Pascagoula River system. The Apalachicola River system and the Pascagoula River system have relatively small parts of their drainage areas within Alabama. Cotton production in Alabama is most intense in the Tennessee Region and the Alabama-Coosa River system in the South Atlantic Gulf Region.

The Tennessee River enters Alabama at the northeastern corner of the State and flows southwest to Guntersville and then leaves the State at the northwest corner (fig. 3-8). Flows in the Tennessee River at the City of Florence, Alabama, averaged 34,850 cubic feet per second (cfs) in 1985 (USGS, 1987b). A series of reservoirs occupy most of the river stretch in Alabama. The largest of these are the Guntersville, Wheeler, Wilson, and Pickwick Lakes. The combined storage capacity of these reservoir dams is 454 billion gallons (USGS, 1986). Locks at the downstream limits of these reservoirs provide for navigation on the Tennessee River through Alabama and upstream to Tennessee and North Carolina (U.S. Army Corps of Engineers, 1981).

The Alabama-Coosa River system drains a total of 17,256 square miles of central Alabama (U.S. Army Corps of Engineers, 1981). The Alabama River is formed by the confluence of the Coosa and Tallapoosa Rivers, just north of the City of Montgomery. The Alabama River then flows southwest toward its confluence with the Tombigbee River, about 45 miles north of the City of Mobile; these two rivers form the Mobile River. Dams have been constructed in this river basin for power generation, flood control, and navigation. The Claiborne, Millers Ferry, and Jones Bluff Locks and Dams facilitate river traffic from the Mobile River upstream to Montgomery (U.S. Army Corps of Engineers, 1981). Several large dams and reservoirs are present throughout the river system. Flows in the Alabama River at the Claiborne Lock and Dam averaged 20,390 cubic feet per second (cfs) in 1985 (USGS, 1987b).

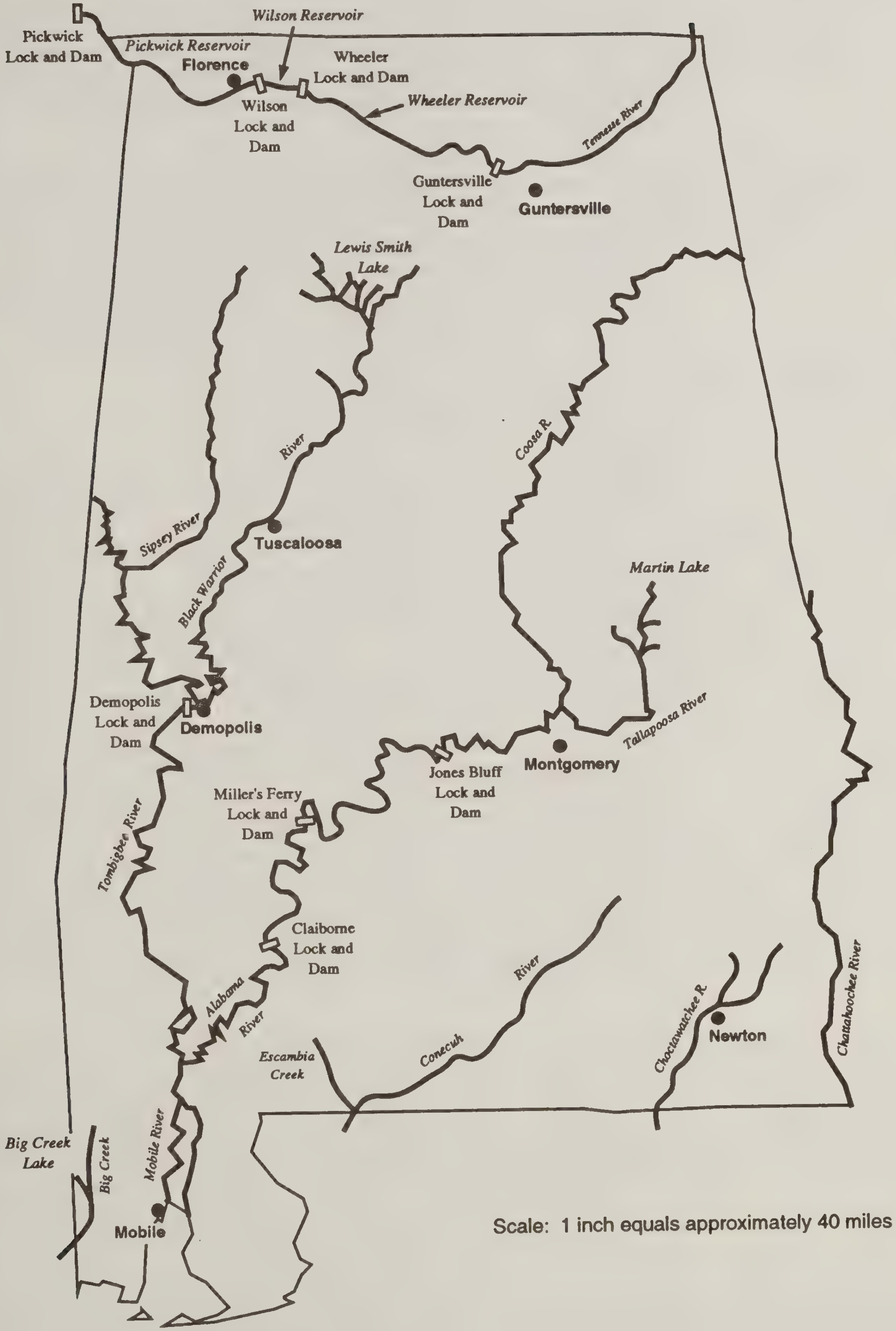
The Mobile-Tombigbee River system drains a large portion of central Alabama. The Tombigbee River rises in northeast Mississippi and enters Alabama near the center of the western State boundary. It is

Figure 3-7. Water Resources Regions and Subregions in Alabama



Source: National Water Summary, 1985—Surface-Water Resources, USGS, 1986.

Figure 3-8. Surface Water Resource Elements



Source: National Water Summary, 1985—Hydrologic Events and Surface-Water Resources, USGS, 1986.

joined by the Black Warrior River near the City of Demopolis and flows south to join the Alabama River 45 miles above the City of Mobile. A series of locks and dams allows the industrial goods manufactured in the center of the State to be shipped southward to Mobile. Flows in the Tombigbee River at the Demopolis Lock and Dam averaged 18,010 cfs in 1985 (USGS, 1987b).

The Choctawhatchee-Escambia River system comprises all the drainage that enters the Gulf of Mexico between the Mobile River and the Chattahoochee River. The two main rivers in this system are the Conecuh-Escambia River and the Choctawhatchee River. Flows in the Escambia River at the southern border of Alabama averaged 5,019 cfs in 1985 (USGS, 1987b). Flows in the Choctawhatchee River near Newton, Alabama, averaged 645 cfs in 1985 (USGS, 1987b).

Surface Water Quality

The surface water quality in Alabama is generally considered good throughout the State (ADEM, 1990). Dissolved solid concentrations in 1986 were typically less than 200 milligrams per liter (mg/L) except in streams in west central Alabama, where concentrations occasionally exceeded 500 mg/L. The pH of the streams was near neutral, and the dissolved oxygen levels seldom fell below 4 mg/L (USGS, 1987b). The Alabama Department of Environmental Management (ADEM), by mandate of the Clean Water Act, assessed 12,016 miles of streams, 507,421 acres of lakes, 103 square miles of estuaries, and 50 miles of shoreline in a water quality assessment for calendar years 1988 and 1989. Approximately 90 percent of the assessed waters were found to fully support their designated uses (suitable for fishing and swimming under the Clean Water Act), although 16 percent of these waters exhibited possible degradation without corrective action. The remaining 10 percent was found to be either fully or partially unable to support designated uses. The primary cause of nonsupport was excessive levels of organic enrichment, which increase the biological oxygen demand and deplete available oxygen supply. The ADEM does not perform surface water pesticide sampling (according to a personal communication with McIndoe, 1990).

The quality of surface water in State reservoirs is of particular concern because reservoirs provide municipal water supply and recreation for local residents. Most of the State's large reservoirs are located in the Tennessee River, Alabama-Coosa River, and Mobile-Tombigbee River drainage systems; and the water quality problems in these reservoirs are similar. Water quality reflects a number of problems associated with municipal, industrial, agricultural, and natural sources (ADEM, 1990). High bacteria counts and low dissolved oxygen levels are common in many reservoirs as a result of nutrient enrichment from agricultural, municipal, and industrial activities. Aquatic weeds and polluted drainage from abandoned surface coal mines also pose threats to smaller reservoirs in the Tennessee River system and the upper areas of the Mobile-Tombigbee River basin. Reservoirs in the Alabama-Coosa

River basin, excluding the Tallapoosa River drainage basin, are the most nutrient-enriched reservoirs in the State because of the fertile alkaline soils in the watershed. In the Tallapoosa River basin, however, soils are infertile and there are no large population centers. This is the only area of the State where cotton is not grown.

Groundwater

Groundwater withdrawals in the State averaged 290 million gallons per day in 1982 (USGS, 1985), which constituted 4 percent of the freshwater used (Baker and Mooty, 1987). Approximately 55 percent of these withdrawals were used for public supply, making up 52 percent of the public's water supply needs (USGS, 1985).

Groundwater aquifers in Alabama are divided into the coastal plain and the noncoastal plain aquifers (fig. 3-9). The principal aquifers of the coastal plain consist of the Citronelle-Miocene aquifer, the Floridian aquifer, the Tertiary sedimentary aquifer, and the Cretaceous aquifer system. The principal noncoastal plain aquifers consist of the Pennsylvanian Sandstone, Paleozoic Carbonate, and Igneous-Metamorphic aquifers. The coastal plain aquifers consist primarily of a sequence of unconsolidated sand beds and limestone and are found at depths of 75 to 200 feet. Yields range from 200 to 1,000 gallons per minute, with aquifers in the central portion of the State yielding as much as 1,400 gallons per minute (USGS, 1985). Most cities and towns on the coastal plain of Alabama depend solely on groundwater for domestic supplies. Some of the larger population centers, including Montgomery, Mobile, and Tuscaloosa must supplement supplies with surface water (USGS, 1985). Big Creek Lake, a 3,600-acre artificial reservoir on Big Creek in the Pascagoula River system, provides another source of drinking water for the City of Mobile.

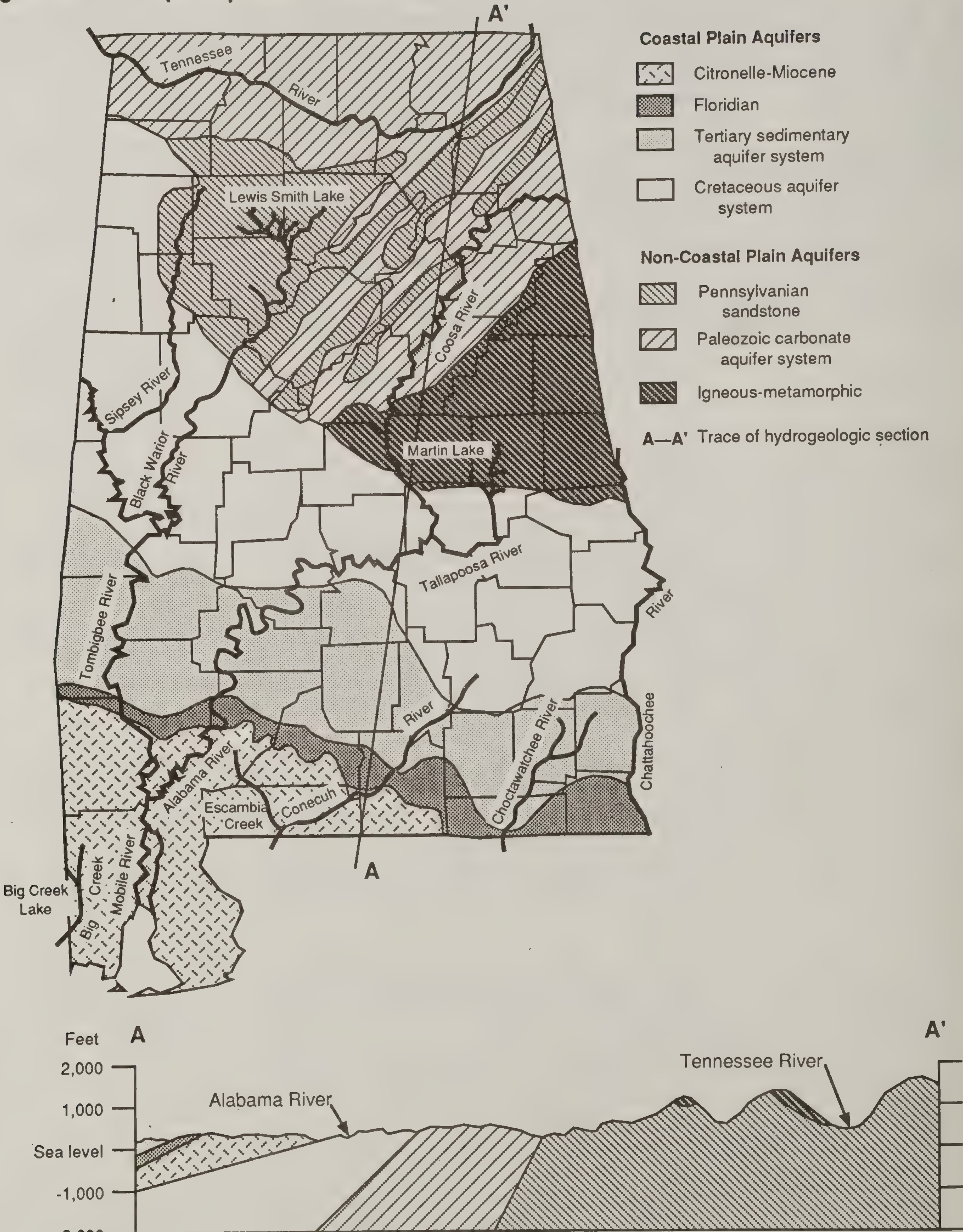
The noncoastal plain aquifers consist of consolidated sediments and carbonate, igneous, and metamorphic rocks (USGS, 1987a). Well depths range from 75 to 500 feet throughout the noncoastal area. The Pennsylvanian Sandstone and Igneous-Metamorphic aquifers have yields averaging 1 to 10 gallons per minute, while the Paleozoic carbonate aquifer system has yields averaging 100 to 500 gallons per minute (USGS, 1985).

Over the past 20 years, Alabama has been experiencing declines in groundwater levels. Between 1973 and 1983, water levels in parts of southwestern Alabama have declined as much as 100 feet (USGS, 1984). Southwestern Alabama is most at risk from declining aquifer levels because of the small areal extent of the aquifers and because of the competition between municipal, industrial, and irrigation uses.

Groundwater Quality

The quality of groundwater in Alabama is generally good for most uses (ADEM, 1990). The complex geology within the State serves to protect many deeper aquifers from contamination. The freshest groundwater

Figure 3-9. Principal Aquifers in Alabama



Source: National Water Summary 1986—Hydrologic Events and Ground-water Quality, USGS,1987

in the State, which contains less than 100 mg/L of dissolved solids, occurs in the recharge areas of all main aquifers.

Groundwater from coastal plain aquifers is typically good because water is pumped from the shallowest aquifers, which are usually near the recharge zone and are least likely to be contaminated. However, unconfined alluvial and coastal plain aquifers, like those on the coastal plain of Alabama, tend to be susceptible to contamination in areas of high population. Population centers provide a large number of point and nonpoint pollutant sources and more avenues for contamination (ADEM, 1990). Leaching of minerals from surface mining spoils, leaking underground storage tanks, surface impoundments, and landfills has caused localized contamination. Excessive pumping in coastal population centers has caused increased groundwater mineralization (USGS, 1987a). Salt intrusion in coastal wells has also become a problem as salinity levels in groundwater continue to rise (USGS, 1984).

The noncoastal plain aquifers were found to have acceptable levels of dissolved solids (USGS, 1987a). Groundwater problems associated with the noncoastal aquifers in Alabama include high iron levels and corrosive pHs. For most domestic purposes, water hardness above 100 mg/L is not objectionable; hardness levels in the non-Coastal Plain aquifers are consistently measured below this level (USGS, 1987a). ADEM has begun a groundwater pesticide monitoring program in selected wells in row crop areas.

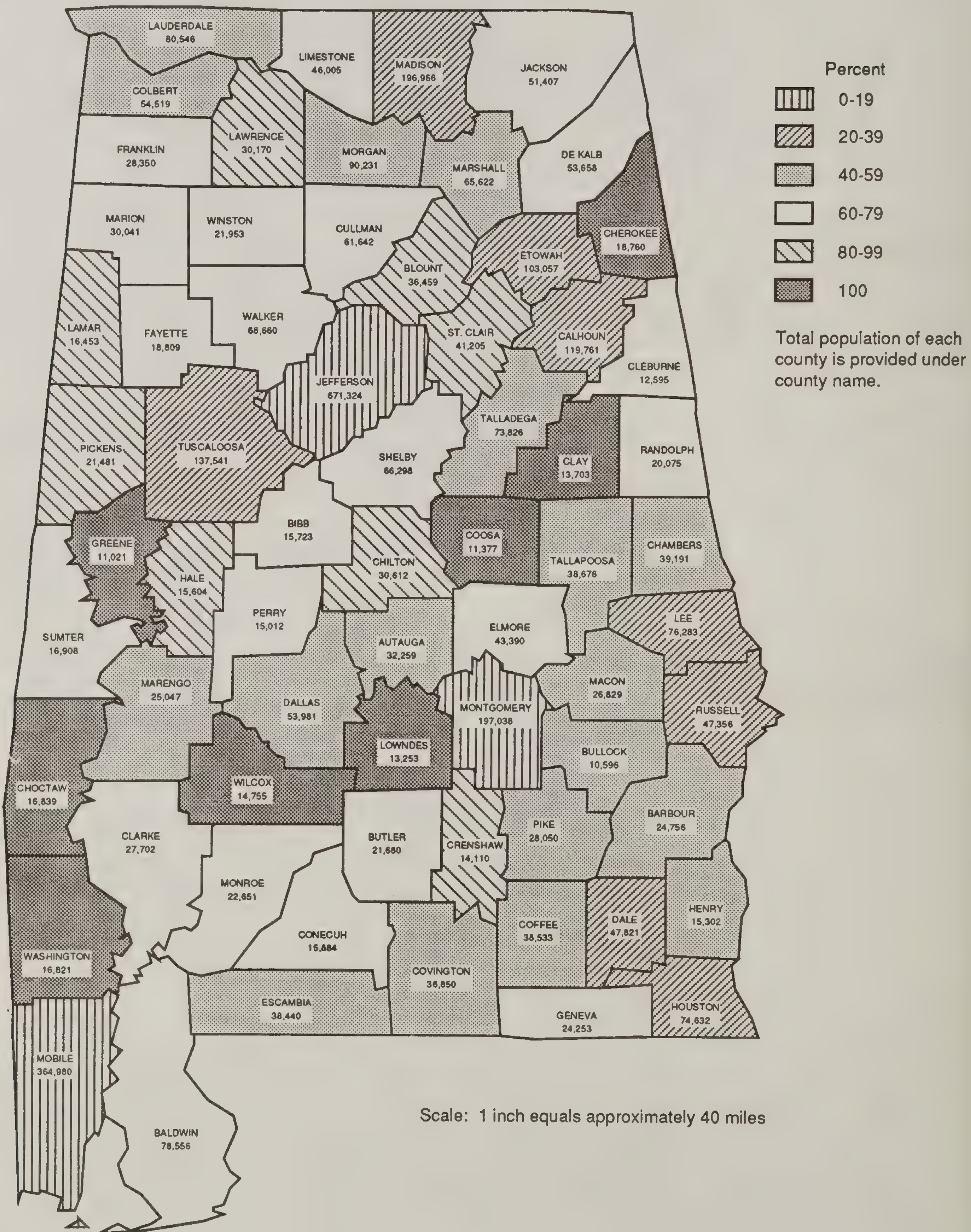
Human Populations

The total population of Alabama increased from 3.4 to 4.1 million between 1970 and 1988. This represents a 19-percent growth rate, slightly less than the 21-percent increase in total U.S. population and substantially less than the 35-percent increase in the Southern U.S. population during that time (USDC, 1990).

Rural residents account for between 10 and 100 percent of the total population in Alabama counties; 8 of the State's 67 counties (12 percent) are entirely rural (ADECA, 1989) (fig. 3-10). Most of Alabama's residents (60 percent) are located in urban areas; the proportion of rural residents has declined from 45 percent in 1960 to 40 percent in 1980 (ADECA, 1989). The trend toward urbanization began in the late 19th century when industrial development attracted farm workers to urban areas (Lineback and Traylor, 1973).

Alabama is not as densely populated as most of the States in the southern region of the United States. In 1988, Alabama had an average of 81 people per square mile, compared to an average of 97 people per square mile in the Southern United States (USDC, 1990). The population density within Alabama counties in 1980 ranged from 16 people per square mile in Washington County to 600 per square mile in Jefferson County. Most of the rural counties had between 16 and 19 residents per square mile; the most densely populated averaged 34 per square mile (ADECA, 1989).

Figure 3-10. Distribution of 1980 Rural Population in Alabama



Source: ADECA, 1989.

Population centers in north Alabama include Huntsville, in Madison County; Florence, in Lauderdale County; and Decatur, in Morgan County. Each of these cities is located in significant cotton-producing counties. Alabama's largest city, Birmingham, is not located in a cotton-producing county; however, Shelby County, a rapidly growing county adjacent to the City of Birmingham, does have some acres devoted to cotton production. In central Alabama, the Cities of Selma and Montgomery are located in or adjacent to counties with significant cotton production. The southern Alabama Cities of Mobile and Dothan are located in areas of less significant cotton production.

Special Groups

Individuals vary in their susceptibility to toxic substances in the environment. These variations in susceptibility can be the result of diet, age, heredity, preexisting physical conditions, and lifestyle (Calabrese, 1978). The Alabama population has not been statistically characterized for these factors. However, the young and the elderly are generally more sensitive than other groups.

In 1988 in Alabama, 39.7 percent of the population was in a sensitive age group: 1,115,000 residents 17 years old or less (27.2 percent) and 513,000 individuals 65 years or older (12.5 percent) (USDC, 1990). No information is available about the portion of these young and elderly populations that may be located close enough to a boll weevil control operation to have any potential exposure to the insecticides. However, one-third of the 1988 U.S. farm population was in a sensitive age group: 20.2 percent of the population was under 17 years old and 14.1 percent was 65 years or older (USDC, 1990).

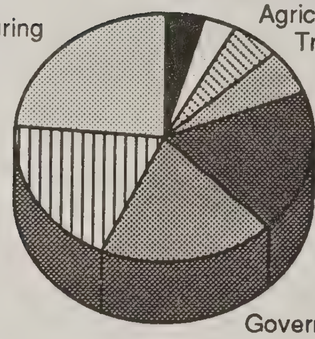
Background Health Risks

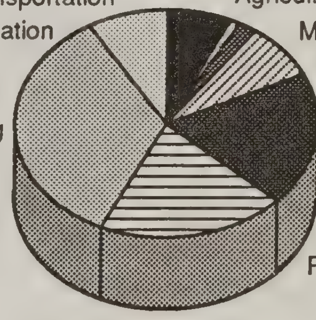
In 1986 in Alabama, a total of 931.3 deaths from all causes occurred per 100,000 population (USDC, 1990). Of these, 393.6 were attributed to cerebrovascular and cardiovascular disease, 201.9 to cancer, 33.2 to chronic respiratory disease, and 54.2 to accidents. These rates are slightly higher than the U.S. average of 873.2 deaths per 100,000 population from all causes, including 379.6 from cerebrovascular and cardiovascular diseases, 194.7 from cancer, 31.8 from chronic respiratory diseases, and 39.5 from accidents. Injuries are the main cause of death among young adults and children nationwide (NRC, 1985). Nationwide, the chance of developing some form of cancer during one's lifetime is about one in four (Calabrese and Dorsey, 1984; NRC, 1987).

Economics

All sectors of the economy are important to Alabama's growth and stability. Manufacturing, wholesale and retail trade, government, and services contribute the greatest amount to income and employment, but the smaller industries, such as construction and mining, are also significant (fig. 3-11). Farm income represented 2 percent of the total value of goods and services produced in Alabama in 1986, as compared to manufacturing, which provided 24 percent of the total value (fig. 3-12). Alabama is less dependent now on farming as a source of income than it has been in the past (Holmes, 1988).

Figure 3-11. Alabama Labor Force and Payroll, by Industry



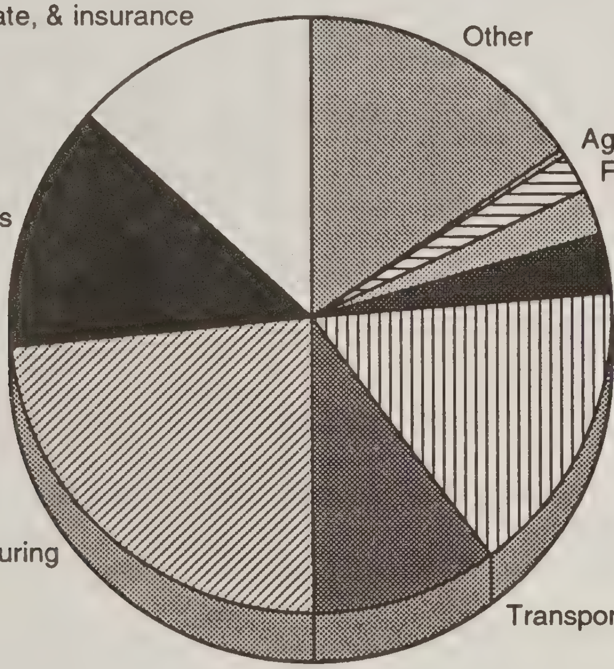


Civilian labor force in 1988 by industry	Number of Employees	Percent of totals
Manufacturing	401,000	23.6
Retail & wholesale trade	332,000	19.6
Government	325,000	19.2
Services	316,000	18.6
Construction	101,000	6.0
Transportation & communication	90,000	5.3
Agriculture	59,000	3.5
Finance, real estate & insurance	72,000	4.2
Total	1,696,000	100

Payroll, by industry ,1986	$1,000	Percent of total
Manufacturing	6,647,865	34.4
Retail & wholesale trade	3,893,084	20.1
Services	3,662,548	19.0
Construction	1,519,383	7.9
Mining	383,846	2.0
Transportation	1,659,429	8.6
Agriculture	59,631	0.3
Finance, real estate & insurance	1,332,084	6.9
Non-classifiable	148,344	0.8
Total	$19,306,214	100

Source: Information Publications, 1990.

Figure 3-12. Value of Goods and Services Produced in Alabama, 1986



Industry	$ Millions	Percent of total
Manufacturing	12,918	23.5
Services	7,397	13.4
Finance, real estate, & insurance	7,240	13.2
Transportation & public utilities	5,569	10.1
Retail & wholesale trade	8,855	16.1
Construction	1,754	3.2
Mining	1,389	2.5
Farms	1,134	2.1
Agriculture services, forestry, & fisheries	197	0.4
Other	8,554	15.5
Total	$55,007	100

Source: Information Publications, 1990.

Per capita earnings from farming statewide were $185 in 1986 and ranged from $1,131 per person in Cullman County to $1 per person in Escambia County. These statewide earnings are slightly greater than the national average of $182 in per capita earnings from farming in 1986 (Holmes, 1988). Total Alabama per capita income in 1986 was $11,357, lower than the average U.S. per capita income of $14,597. Per capita earnings from farming accounted for 1.6 percent of 1986 per capita personal income in the State. However, this understates the overall economic impact of farming on the State because much of the manufacturing in Alabama uses farm-produced raw materials, such as broiler chickens and cotton. In addition, many merchants depend on selling farm inputs, such as chemicals, for a significant part of their earnings (Holmes, 1988).

Income in rural Alabama is lower than in metropolitan areas. In 1988, per capita income in Alabama's metropolitan areas ranged from $11,679 to $16,330. In contrast, per capita income in the eight rural counties (fig. 3-10) was lower than the State average of $12,846 for all metropolitan areas and ranged from $8,531 in Greene County to $11,327 in Clay County (State of Alabama Department of Industrial Relations, 1990).

Alabama's rural areas are also characterized by greater unemployment than the rest of the State. Nine of the ten counties with the highest unemployment rates are primarily rural (table 3-1). Approximately 7 percent of Alabama's labor force was unemployed in 1989. This was higher than the U.S. average of 5.3 percent (State of Alabama Department of Industrial Relations, 1990).

Agriculture

Livestock, including broilers, cattle, hogs and dairy products, and crops, are important to the agricultural economy of Alabama. The State is the third largest producer of broilers and catfish in the United States, with 13.4 and 8.2 percent of the total U.S. production, respectively (ADAI, 1988). Livestock and poultry products accounted for $1,695 million, or 68 percent of the total agricultural receipts in 1988 (table 3-2). Crops such as peanuts, cotton, soybeans, and vegetables made up the remaining 32 percent of cash receipts, totaling $786 million.

Cotton

Cotton is the sixth most important commodity in Alabama in terms of revenue. Cash receipts for cotton lint and cottonseed totaled $120 million in 1988 and represented 15 percent of total crop receipts and 5 percent of all farm commodity receipts. Alabama is the eighth largest producer of cotton in the United States (ADAI, 1990). In 1988, 375,000 acres of cotton were harvested and 380,000 bales of cotton were produced in the State. Six northern counties—Limestone, Madison, Lawrence, Colbert, Lauderdale, and Cherokee—were responsible for 50 percent of the State's 1988 cotton production (fig. 3-13). The yield per harvested acre for all counties averaged 486 pounds, ranging from 154 pounds in Marshall County to 808 in Talladega County.

Table 3-1. Alabama Counties With the Highest Unemployment, and Their Rural Population

Rank	County	Percent unemployed, 1989	Percent rural, 1980[a]
1	Wilcox	14.6	100
2	Butler	13.5	64
3	Bullock	12.7	58
4	Dallas	12.0	41
5	Greene	12.0	100
6	Marion	11.8	71
7	Lowndes	11.7	100
8	Washington	11.6	100
9	Lawrence	11.5	89
10	Jackson	11.5	61
	State of Alabama	7.0	40

[a] Data unavailable from 1990 census.

Sources: State of Alabama Department of Industrial Relations, 1990; ADECA, 1989.

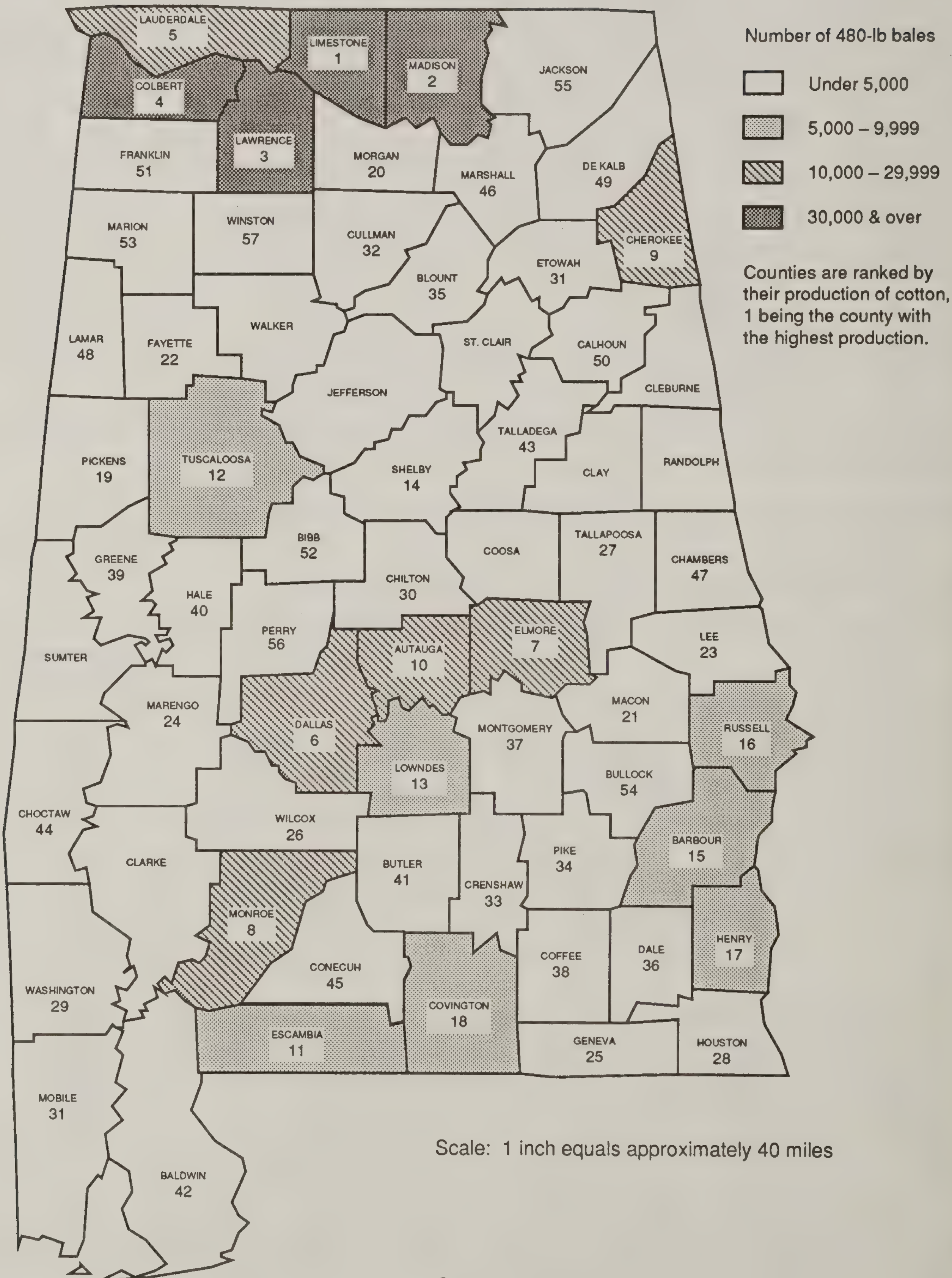
Table 3-2. Cash Receipts From Alabama Commodities (1988)

1988 rank	Item	Cash receipts ($ millions)
1	Broilers	936.5
2	Cattle and calves	452.7
3	Greenhouse and nursery	162.7
4	Peanuts	157.3
5	Eggs	143.4
6	Cotton	120.0
7	Farm forest products	89.6
8	Soybeans	87.7
9	Dairy	73.8
10	Vegetables	60.0
11	Hogs	46.7
12	Wheat	25.5
13	Hay	23.3
14	Catfish	19.4
15	Corn	14.3
16	Fruits	13.0

Note: These 16 commodities accounted for 98 percent of the total cash receipts from all farm commodities in 1988.

Source: ADAI, 1990.

Figure 3-13. Alabama Cotton Production, 1989



Cotton is produced in 55 of Alabama's 67 counties.

Source: ADAI, 1989.

Culture

Many culturally significant sites are located throughout Alabama (fig. 3-14). Every county, except Choctaw, has sites listed on the National Register of Historic Places (USDI, 1976). Archaeological sites and monuments (such as the Moundville State Monument in Tuscaloosa County) provide information about prehistoric and historic Indian cultures.

The importance of agriculture in the State's history is demonstrated by the many antebellum homes and plantations, such as Gainswood, a Greek revival mansion, and Bellingrath Gardens and Home (located in Marengo and Escambia Counties, respectively). Other areas, including forts, battlefields, cemeteries, museums, and monuments, preserve elements of Alabama's history during the 17th, 18th, and 19th centuries (ADECA, 1989; USDI, 1976).

Prehistoric

Evidence of human presence in Alabama during prehistoric times was discovered in Russell Cave near Bridgeport (Jackson County) in 1953. Broken utensils and charcoal remains of fires found in the cave were dated from between 6500 and 7000 B.C. Clovis points, a type of spear point used by Ice Age hunters to kill big game, were later found at the Quad site near Decatur, Alabama. Archaeologists have dated excavated materials in that area and believe Indian hunters came into the Tennessee Valley of Alabama as early as 10,000 B.C. in pursuit of big game, such as prehistoric mastodons and woolly mammoths.

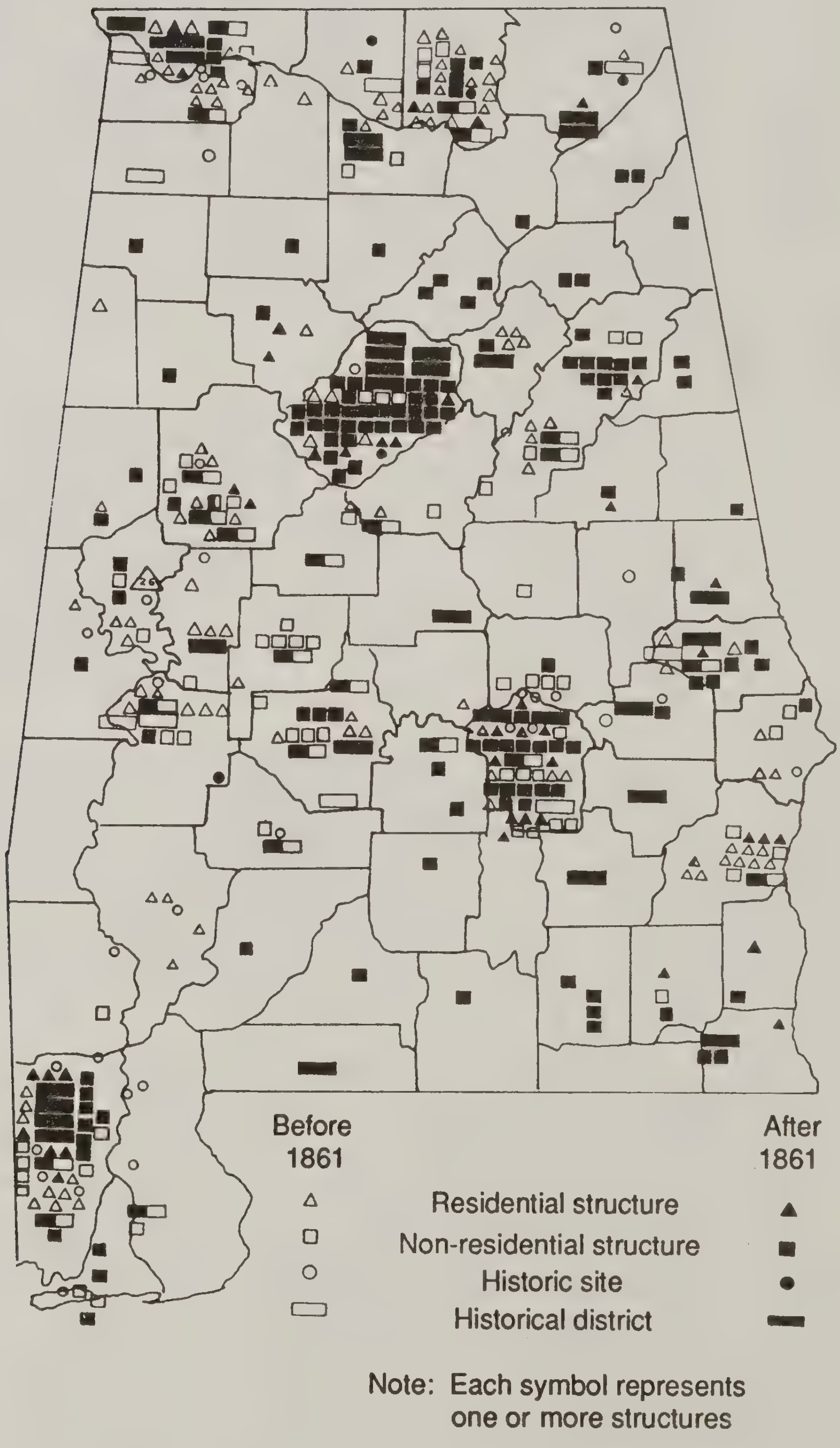
Archaeological remains of prehistoric Indians in Alabama range from "rock towns" or cave shelters along the river bluffs to the earthen pyramids and fortified town sites of the semicivilized people known as the Mound Builders. Throughout the State, particularly in the large drainage basins, there are large habitation sites, shell refuse heaps, and terraced flat-top ceremonial mounds, which served as foundations for temples or houses. The Moundville State Monument is one of the most well-preserved mound groups in the country (Walker, 1975).

Historic

The Spanish are the earliest known European explorers of Alabama. Several expeditions searching for gold arrived during the 16th century. Some arrived in Mobile Bay, while others (including Hernando de Soto's) traveled along inland routes from what is now Florida and Tennessee. The first permanent European settlements were established by the French in the early 18th century soon after France relinquished her claims in the Treaty of Paris (1763). The British acquired a small area in the southern part of the State in the treaty, and Spain continued to hold claim to other parts of the State. During the late 18th century and early 19th century, the United States gradually acquired the Mississippi territory (of which Alabama was part) from the Spanish and the Indians through invasions, civil wars, and treaties.

Historic tribes included the Choctaw, Chickasaw, Cherokee, Creek, and Alabama. By the mid-19th century the Indian culture had virtually disappeared from the State. Continuous conflicts and disease (such as smallpox and measles) reduced Indian populations. The U.S.

Figure 3-14. Alabama Sites on the National Register of Historic Places



Source: ADECA, 1989.

acquisition of Indian lands and the eventual relocation of the Indians to Oklahoma left 160 Indians in the entire State in 1860.

Agriculture

The dominance of agriculture in Alabama derives from the availability of large areas of productive agricultural land after dispersion of the Indians. Also, during the 19th century farm families from Georgia, North and South Carolina, Tennessee, and Virginia migrated to Alabama. (Some Europeans, including refugees from Ireland and Germany, settled in Alabama. However, 85 to 90 percent of the State's pre-Civil War white population was from the northern States or was descended from these original settlers.) Farming was becoming less profitable in these older States primarily because many rich soils were depleted after being continuously planted with cotton or tobacco and because the most productive areas in the States were owned by relatively few established families. Distribution (free or at low cost) of productive agricultural land (former Indian territory) by the Federal Government also provided an incentive to migrate to Alabama (Lineback and Traylor, 1973).

Cotton. In 1821 the beginning of steamboat service up the Alabama River to Montgomery made the seaport of Mobile easily accessible to Alabama cotton planters. Slave labor and the increasing number of cotton gins made cotton a mass production crop. The first cotton factory in the State was erected in Madison County in the early 1830s, and a cotton gin manufacturing plant was established in Montgomery County in 1833. As the port of Mobile opened the markets of the world to this commodity, cotton became the economic backbone of the State (Walker, 1975).

Alabama's economy revolved around cotton for most of the first 60 years of the 19th century. Other pre-Civil War industries included iron foundries, shoe factories, grist and lumber mills, and nitre (mineral used to make gunpowder) manufacturing. As a result of the reliance on cotton throughout the first half of the 19th century, the soil was badly depleted. After the Civil War a move toward industrialization occurred, centering around textile, iron, and steel production. Cotton was further deemphasized late in the 19th century by boll weevil crop destruction. Peanuts and potatoes then became alternate crops (Lineback and Traylor, 1973).

Visual Resources

Visual resources consist of the land, water, vegetation, animals, and other natural or manmade features visible in Alabama. Highways, rivers, and trails of the area pass through a variety of characteristic landscapes where natural attractions, such as forests and coastal marshes, can be seen and where cultural modifications exist. Vast acreages of cropland, pasture, and forest land provide scenic views.

Alabama's visual resources vary because of the State's topography and diverse land uses. The steep terrain prevailing in the Appalachian

foothills limits the range of view but provides rugged mountain vistas. Occasional valleys and streams provide more open panoramas in this area of northern Alabama. The Tennessee River Valley is also characterized by hilly terrain, but it is broken up more frequently by flat to rolling areas. The southern part of Alabama (including the coastal marshlands and the Mobile River estuary) is fairly flat to rolling and, therefore, provides open scenic vistas. Different vegetation and wildlife are evident in riparian and coastal areas.

Most uses of land in the State—agriculture, forest land, and urban—also influence visual qualities. In agricultural areas, green fields planted with row crops, such as cotton, peanuts, soybeans, potatoes, and hay, are commonly seen. Some of these plants flower in the spring and provide additional color. The relatively flat topography typical of agricultural areas is broken by farm houses, barns, silos, fences, farm machinery, small aircraft (used for crop dusting), and livestock grazing in open fields. Additionally, the reddish-yellow to brownish-red soil enhances the vistas when fields are tilled during the spring and fall (Lineback and Traylor, 1973).

Many different trees and other vegetation may be seen in Alabama because forest land occupies approximately one-third of the State. Scattered horizons in the southern part of the State are dominated by coniferous loblolly pine forests, while various deciduous hardwood forests are common in northern parts of the State.

Air Quality

Under the Clean Air Act of 1977, as amended, Alabama is required to ensure that concentrations of designated pollutants do not exceed Federally mandated air quality standards. This is done on the State level by preparing a State Implementation Plan (SIP), which outlines Alabama's program to meet the Federal standards and, when the Federal standards are exceeded, allows for plans to achieve attainment (Currie, 1989). EPA must approve the original SIP, as well as all modifications. When an area in the State does not meet the Federal standards for a specific pollutant, it is referred to as a nonattainment area.

Air quality, for purposes of the Clean Air Act, is measured by comparing air pollutant levels with appropriate primary and secondary National Ambient Air Quality Standards (NAAQS) for each of six criteria air pollutants. (Primary standards apply directly to human health, while secondary standards consider the health of surrounding flora and fauna.) These six pollutants include total suspended particulates, sulfur dioxide, ozone, nitrogen dioxide, carbon monoxide, and lead (40 CFR 50 et seq.).

In 1989, air quality at all monitoring stations met the primary and secondary NAAQS for sulfur dioxide, carbon monoxide, and ozone (EPA, 1990). Air samples in two cities exceeded the maximum 24-hour standard for total suspended particulates during at least one-quarter of 1989: one station in Dothan (Houston County) and two stations in

Birmingham (Jefferson County). Two stations in Leeds (Jefferson County) and one station in Troy (Pike County) collected air samples that exceeded the standard for lead concentrations during at least one-quarter of 1989 (EPA, 1990). All six nonattainment areas are in urban areas.

Noise

The sound environment in Alabama may be characterized by ambient noise levels and factors that influence these levels. In Alabama, as in other States, a dichotomy exists between urban and rural areas, with much lower average background noise levels found in the latter.

General farm activity, in the absence of any heavy machinery being operated, is approximately 50 to 80 decibels (dBs) (Plog, 1988). Periodic increases in dB levels may occur from the operation of agricultural equipment, such as trucks, tractors, harvesters, and aircraft used to apply pesticides.

Trees and shrubbery serve to dampen the noises typical of agricultural areas. The terrain also affects the ambient noise level, with sounds carrying farther over flat terrain than over hills and valleys.

Section 4

Environmental Consequences

Overview

This section discusses the potential environmental impacts of implementing the next increment of the National Boll Weevil Cooperative Control Program in central and northern Alabama. This section evaluates the possible consequences of implementing the next phase for each of the environmental resources described in section 3. Also presented are potential cumulative and synergistic environmental effects, unavoidable environmental effects, irreversible and irretrievable commitment of resources, short-term uses versus long-term productivity, conflicts with other agencies, and energy requirements and conservation potential. In some instances, the likely impacts would not differ from those for the 17-State beltwide program, as discussed in this EIS. In those cases, the reader is referred to the appropriate chapter to avoid unnecessary repetition in this document.

Geology and Topography

Geology interacts directly and indirectly with all other environmental factors. For example, the rock type found in a specific area can influence soil development, composition of vegetation communities, and plant growth rates. Soil moisture retention is indirectly related to the geologic material and weathering conditions. The environmental resources most closely associated with geology are soil and water resources. Although the program may affect these related elements, it is not expected to have any direct impact on geology and topography.

Climate

The factors influencing climate are so large in scale compared to the size of implementing the next increment that it is not expected that there would be any impact, even briefly, on the climate in Alabama.

Soils

The EIS contains a complete discussion of the potential impact of malathion and diflubenzuron on soils. No additional impacts are expected from using these two chemicals in central or northern Alabama.

Additional information suggests that soils will not be adversely affected by the use of methyl parathion. For instance, in a study on loam and sandy soils, a normal application of methyl parathion (50 ppm) resulted in little impact to microflora and had a stimulatory effect on populations of fungi, actinomycetes (Naumann, 1971; as cited in Tu and Miles, 1976), and nitrifiers (Naumann, 1970; as cited in Tu and Miles, 1976).

Vegetation

Methyl parathion and diflubenzuron are generally nonphytotoxic when used at label rates (Thomson, 1989) and therefore are not expected to affect vegetation in fields adjacent to cotton. Damage from malathion has been reported on a variety of fruits, cucurbits, string beans, and some ornamentals, including ferns, hickory, viburnum, lantana, junipers, petunias, spirea, white pines, maples, and elms (Thomson, 1989).

However, no information was available on the formulation of malathion that caused the damage or the extent of damage.

There is evidence that some formulations of methyl parathion are phytotoxic to cotton. Field studies conducted in 1972 and 1986, using methyl parathion 5 EC and methyl parathion 4 EC at application rates of 1.12 kg active ingredient (a.i.)/ha (1 lb a.i./acre), resulted in adverse effects on cotton growth, reproductive development, and yield (Youngman et al., 1990). However, the formulation proposed for use in the national program is not the same as those tested; the application rate in the program would be one-half of that used in the field studies.

The reproduction of vegetation adjacent to cotton fields that were treated with malathion and methyl parathion may be adversely affected for a short period because of the reduction of insect pollinators. No long-term impacts to vegetation are anticipated because of the short duration of the program and the short persistence of the insecticides on plants.

Federally Listed Endangered, Threatened, and Proposed Plant Species

Twelve plant species that occur in Alabama are listed by the Fish and Wildlife Service as endangered or threatened, or are proposed for listing. These species were evaluated in terms of the potential for the program to affect their continued existence. Attachment B describes the biology of each species, the risk assessment process used to determine whether they are likely to be affected, the conclusions of the assessment, and the protection measures developed to ensure that none of the "may affect" species is jeopardized by the Alabama program.

Program "No Effect" Plant Species

It was determined that the following seven plant species would not be affected by the proposed boll weevil control program in Alabama:

- American hart's-tongue fern
- Alabama canebrake pitcher-plant
- Green pitcher-plant
- Lyrate bladder-pod
- Price's potato-bean
- Leafy prairie-clover
- Little amphianthus

Program "May Affect" Plant Species

It was determined that the following five plant species would possibly be affected by the proposed boll weevil control program in Alabama (measures described in attachment B were developed to protect these species):

- Alabama leather flower
- Harperella (Piedmont Bishop's weed)
- Mohr's Barbara's buttons

- Kral's water-plantain
- Relict trillium

Nontarget Terrestrial Wildlife and Aquatic Species

Wildlife and aquatic species may be affected if they are exposed to the program pesticides, or they may be temporarily disturbed by the application equipment during the next phase of the program in central and northern Alabama. Only individual animals are likely to be affected; no major population of wildlife or aquatic species is likely to be seriously affected, and no other aspects of the program are likely to affect them. The potential impacts on endangered and threatened species of wildlife and aquatic species are discussed later in this section.

Wildlife and Aquatic Species Risk Assessment

The possibility that any terrestrial or aquatic organism might be affected by the control program insecticides is a function of the toxicity of the chemical to that type of organism and the level of exposure that organism is likely to experience during the program. To evaluate that possibility, a risk assessment was conducted that combined information on the toxicity of the program chemicals with estimated exposures that various Alabama species might experience. The risk assessment for Alabama species adapted the methodology used for assessing program-wide risks as described in appendix B. The risk assessment compared toxicity levels found in laboratory studies with estimated exposures of representative Alabama wildlife and aquatic species that are common inhabitants of the State.

Wildlife Risk Estimates

The representative Alabama wildlife species used in the risk assessment included birds, mammals, reptiles, amphibians, and domestic animals with a range of body sizes and diets for which these biological parameters were generally available. Some common terrestrial invertebrates were also included. These species were assumed to receive insecticide doses through three exposure routes simultaneously: by breathing in insecticide droplets immediately after spraying, by absorbing insecticide through the skin, and by consuming food and water contaminated with insecticide.

Typical and extreme doses of each control chemical were estimated for each wildlife species based on insecticide from drift or direct spray exposures. These estimated doses were then compared with the acute toxic dose level that EPA (1986) suggests as a risk criterion for terrestrial species—that is, 1/5 of the LD_{50} (toxic dose lethal to one-half of a test group of animals) of the most closely related tested species. For example, estimated doses of malathion to the red fox were compared to the laboratory-determined LD_{50} of the domestic dog. Because so little toxicity data are available for reptiles and terrestrial stages of amphibians, bird data were used as a surrogate. For nonendangered wildlife species, EPA assesses the risk from pesticide exposure according to the following scale:

Low—expected dose <1/5 LD_{50}
Moderate—1/5 LD_{50} ≤expected dose <LD_{50}
High—expected dose ≥LD_{50}

Doses below the 1/5 LD_{50} level (slight) are assumed to present a low or negligible risk, doses between the 1/5 LD_{50} level and the LD_{50} (moderate) are assumed to present a risk that may be decreased by the restricted use of pesticide, and doses above the LD_{50} (high) are assumed to present an unacceptable risk. Attachment A presents the details and results of the Alabama wildlife and aquatic species risk assessment.

Aquatic Species Risk Estimates

The aquatic species portion of the risk assessment compared the expected environmental concentrations (EECs) of program insecticides from drift or runoff into ponds, streams, and rivers to LC_{50}s (concentrations lethal to one-half of a test group) from laboratory tests on similar species. The following risk categories from EPA (1986) were used to assess the control program's effect on aquatic species in Alabama:

Low—EEC <1/10 LC_{50}
Moderate—1/10 LC_{50} ≤EEC <1/2 LC_{50}
High—EEC ≥1/2 LC_{50}

The American oyster was used as a toxicity surrogate for the effects of malathion on freshwater mussel species in Alabama. For the effects of diflubenzuron and methyl parathion on freshwater clams, fish were used as toxicity surrogates because evidence suggests that known fish toxicants are comparatively less toxic to freshwater mussels during acute exposure (Havlik and Marking, 1987). For aquatic reptiles, the tadpole of the western chorus frog was used as the toxicity surrogate for malathion and methyl parathion, and the channel catfish was used for diflubenzuron.

Risk Assessment Conclusions

The wildlife portion of the risk assessment reached the following conclusions:

- Malathion would generally be safe with respect to terrestrial species, except for insects such as the honey bee.

- Diflubenzuron would be safe for terrestrial wildlife and is not likely to affect honey bees.

- Methyl parathion would be safe under normal exposures but would affect animals that received significant exposures from being directly sprayed and from feeding exclusively on insecticide-contaminated food.

The aquatic species portion of the risk assessment concluded the following:

- Malathion would likely affect species such as bluegills or painted turtles found in farm ponds and could also affect fish species such as walleyes and invertebrates such as *Daphnia magna* if the ponds or streams were contaminated from insecticide drift (without a buffer) or runoff.

- Diflubenzuron is not likely to affect any aquatic species in Alabama.

- Methyl parathion should not adversely affect any of the fish, clams, aquatic reptiles, or amphibians in Alabama. However, some species of aquatic invertebrates, such as *Daphnia magna* or crayfish, may be at risk from methyl parathion.

Federally Listed Endangered, Threatened, and Proposed Wildlife and Aquatic Species

Thirty-four wildlife and aquatic species in Alabama are listed by the Fish and Wildlife Service as endangered or threatened or are proposed for listing. These species were evaluated in terms of the potential for the program to affect their continued existence. Attachment B describes the biology of each species, the risk assessment process used to determine whether they are likely to be affected, the conclusions of the assessment, and the protection measures developed to ensure that none of the "may affect" species is jeopardized by the Alabama program.

Program "No Effect" Species

It was determined that the following five wildlife and aquatic species would not be affected by the proposed boll weevil control program in Alabama:

- Alabama beach mouse
- Perdido Key beach mouse
- Red Hills salamander
- Pygmy sculpin
- Watercress darter

Program "May Affect" Species

It was determined that the following 29 wildlife species may be affected by the proposed boll weevil control program in Alabama (protection measures described in attachment B were developed to ensure no jeopardy):

- Gray bat
- Indiana bat
- Piping plover
- Bald eagle
- Red-cockaded woodpecker
- Gopher tortoise
- Alabama red-bellied turtle
- Flattened musk turtle
- Eastern indigo snake

- Cahaba shiner
- Alabama cavefish
- Boulder darter
- Slackwater darter
- Snail darter
- Gulf sturgeon
- Tulotoma snail
- Inflated heelsplitter mussel
- Judge Tait's mussel
- Marshall's mussel
- Penitent mussel
- Alabama lamp pearly mussel
- Fine-rayed pigtoe
- Orange-footed pearly mussel
- Pale lilliput pearly mussel
- Pink mucket pearly mussel
- Rough pigtoe
- Shiny pigtoe
- Stirrup shell
- Alabama cave shrimp

Cotton Insect Pests

The proposed implementation of the next increment of the National Boll Weevil Cooperative Control Program could have short-term adverse impacts and long-term beneficial impacts on other cotton insect pests.

As discussed in the EIS, in the absence of chemical treatments, cotton insect pests are often kept below economically damaging levels by predators and parasites. These beneficial predators and parasites are in dynamic equilibrium with their pest prey or hosts. When the pest population increases, the populations of beneficial insects increase as well (Ables et al., 1978). While some annual environmental conditions may favor the growth of some pest species, biological controls can reassert their controlling influence, and pest populations can stabilize again over time.

Boll weevils have no predators, parasites, or naturally occurring diseases that provide an economically acceptable level of control; therefore, insecticides are the only method now available to control large populations of boll weevils in the warm, humid climate of Alabama. When broad-spectrum or nonselective chemicals are applied to control boll weevils, the toxic effects of the chemical may reduce or eliminate the nontarget pests as well as the beneficial insect populations that normally control them. However, if the nontarget pest is unaffected by the chemical treatment, elimination of the beneficial insects may allow the nontarget pest population to grow to levels that would cause damage.

Malathion and methyl parathion are toxic to beneficial insects, and they are not effective in controlling some secondary pests in Alabama, including tobacco budworms, bollworms, beet armyworms, and aphids. Thus, repeated applications of these chemicals may cause elimination of

the beneficial insects and contribute to the population growth of these secondary pest species. In addition, the repeated long-term application of broad-spectrum insecticides may contribute to the development of chemical resistance in target and nontarget species. Several of the nontarget cotton pests in Alabama have already developed some level of resistance to many insecticides. When resistance occurs, beneficial insects may be the only control method available to limit the size of the pest population. Eliminating the beneficial insects in this instance could result in uncontrollable outbreaks of the pest (Knipling, 1979).

The next increment of the program may have the short-term effect of contributing to local outbreaks of aphids, bollworms, and tobacco budworms in the 2 to 3 years when early-season treatments are required for more than two consecutive times. However, in the long term, with the boll weevil eradicated as an economic pest, there would be a significant decrease in the need for insecticide applications early in the season. This would allow for the use of a true integrated pest management system in Alabama for the remaining cotton pest species. For example, with boll weevils eradicated, budworms and bollworms could be managed using control measures such as *Bacillus thuringiensis* and beneficial insects. Also, aphids could be managed with natural predators, parasitoids, and naturally occurring fungal diseases, plant bugs with one insecticide treatment, and seedling thrips with systemic aldicarb (according to a personal communication with Smith, 1990).

Water Quality

The initiation of a control program will not change the water requirements of cotton production and will, thus, result in negligible effects on surface water and groundwater quantity. However, there may be short-term effects on water quality because of the possibility of insecticides entering the aquatic environment. Any short-term effects would be comparable to those that might occur when individual producers, outside the program, attempt to control boll weevil populations.

When released into the environment, chemical insecticides may enter aquatic systems through three main pathways:

- Drift from pesticide application equipment may land on neighboring streams and ponds.

- Runoff from fields may contain insecticide concentrations that enter streams and rivers.

- Pesticides may leach into the ground with infiltrating precipitation and enter groundwater resources.

Mathematical models predicted the concentration of insecticides entering the aquatic environment through these methods. This analysis required three models: AGDISP (Agricultural Dispersal Model), GLEAMS (Groundwater Loading Effects of Agricultural Management Systems), and EXAMS II (Exposure Analysis Modeling System). A

discussion of these models and the assumptions and methodologies used is provided in attachment A.

Surface Water Quality

Surface water quality will potentially be affected by the program, but any effects will not be long term. Insecticides may enter aquatic environments only during treatments adjacent to those environments or during rainfall events that generate runoff. All the insecticides considered for the program degrade rapidly and will quickly disappear from the aquatic environment and soils. In general, insecticide concentrations will be highest in aquatic environments adjacent to treated fields, such as farm ponds and small streams, but the concentrations will decrease with increased downstream distance in the watershed. Increased water volumes downstream help dilute dissolved insecticide. Rapid degradation of the proposed program insecticides further decreases the insecticide concentrations.

The GLEAMS model (Leonard et al., 1987, 1988) was used to determine water concentrations in undiluted field runoff. Cotton production soils, such as sandy loam, silt loam, sand, and loam, were examined. A detailed discussion of the modeling methodology and results is included in appendix B. According to the model, more than 60 percent of the insecticide residues in the runoff were found in the dissolved portion. The remainder were adsorbed to eroded sediments, which are less available for fish and wildlife intake. The insecticides are diluted immediately downstream of the point of discharge. This dilution will be sufficient in many cases to reduce insecticide concentrations to safe levels. Accordingly, maximum impacts to wildlife could occur closest to the point of runoff discharge.

GLEAMS and AGDISP were used to examine the effects of insecticide runoff and drift, respectively, on farm ponds. Farm ponds are particularly susceptible to drift deposition because of their large surface areas, shallow depths, proximity to cotton production areas, and long residence times (that is, the same water sits in the pond for long periods without the introduction of new water). A discussion of the potential impacts of the program on farm ponds is provided in chapter 4 for the cooperative control program.

EXAMS II estimated the riverine concentration of insecticides under the proposed eradication program. The model was used to examine concentrations of diflubenzuron, malathion, and methyl parathion in the Tennessee and Alabama Rivers during a storm event. At their peak, insecticide loadings in the modeled rivers were several orders of magnitude lower than the maximum insecticide concentrations leaving the cotton fields. The water quality of the rivers is not expected to be significantly affected by the control program. A detailed discussion of the EXAMS II modeling methodology and results is presented in attachment A.

Results from the GLEAMS model were also used to examine the residues of the insecticides that remain in the soil on the field. The

results of the analysis indicate that for all insecticides and all representative soil types, no cumulative buildup of residues in the soil is expected. In each year of the program, the maximum buildup of residues occurs at the end of the maximum application period and decreases rapidly. While the sandier soils exhibited residual pesticide longer than the other soils, no insecticide was present in any soils when the next application year began.

Groundwater Quality

The GLEAMS model output provided information on the potential of insecticides to leach below the root zone and possibly into the groundwater. The modeling results indicate that percolation through the soil (even during extreme storm events) is negligible, and no pesticide percolated through the root zone, which was modeled assuming a 40-inch (100-cm) depth. None of the insecticides reached a depth of more than 20 inches (50 cm). Malathion generally reached the highest concentrations in soils and migrated farthest downward through the soil, although it never reached the groundwater in significant quantities. As discussed previously, all of the insecticides readily degrade. They are also readily adsorbed to the soil. Based on these two processes and on the results of the GLEAMS model, none of the insecticides should reach the groundwater in any significant amount.

The Alabama Department of Environmental Management and the Alabama Department of Agriculture and Industries are conducting a groundwater monitoring study, the results of which will be used to develop a groundwater protection strategy for pesticide applications in Alabama. The monitoring for phase I of this study was completed in 1989. This phase sampled 50 private wells in 10 counties to determine occurrences of pesticides in groundwater. Each well was sampled in early May, late June or early July, and mid-August. In the 150 samples taken, only 1 sample contained a detectable concentration of malathion—0.09 parts per billion (ppb). This well was located in Colbert County. No diflubenzuron or methyl parathion was detectable in any samples. In phase II of this program, additional wells are being sampled in each county sampled in phase I. Another phase of the study will involve the installation of monitoring wells adjacent to cotton fields for a more complete picture of pesticide fate.

Human Health and Safety

Two groups of people may be affected by the proposed boll weevil control program in Alabama—workers and certain members of the public. The workers would include both APHIS program people and contract applicators involved in applying one of the three program insecticides or engaged in other boll weevil control activities. Members of the public may be affected only if they are present near the edge of a cotton field while it is being treated or if they consume food or water with insecticide residues. The program should not affect anyone else's health or safety.

Workers could be injured during operation of the aircraft, hiboys, or mist blowers used in the application of the program insecticides. Growers could be injured during postharvest stalk destruction. There

is some risk of fatalities from those injuries during applications, particularly in the case of an aircraft accident. Routine safety precautions that are among the standard operating procedures (section 2) for aircraft and farm equipment use should minimize the possibility of serious injuries or fatalities. The public is not at a significant risk of injury from these types of accidents.

There is some risk that workers and the public may become ill from being exposed to the program insecticides. In particular, malathion and methyl parathion are among the organophosphate pesticides known to interfere with the functioning of the human nervous system by binding to the enzymes involved in the transmission of nerve signals. Repeated smaller doses are effectively equivalent to a single large dose because this binding process is irreversible until the body has had enough time to manufacture additional enzymes. Diflubenzuron does not produce this effect. Sufficient enzyme inhibition can lead to symptoms of poisoning, such as headaches, nausea, and dizziness.

Fatalities may result from severe exposure if immediate treatment is not available, but the possibility of such an exposure would be limited to the workers who routinely handle large quantities of the insecticide concentrates. No member of the public is likely to receive such a high dose. There is also some evidence from laboratory animal studies that the control program insecticides might also produce longer term health effects, such as reproductive effects or cancer, in exposed individuals.

A risk assessment was conducted to evaluate the possible human health effects of the program insecticides. The risk assessment estimated insecticide doses that workers or members of the public might receive and compared those doses with dose levels found to produce no toxic effects in tests on human volunteers and laboratory rats. The details of the assumptions used to estimate each type of dose and the risk evaluation criteria are given in attachment A.

Worker and public doses were estimated from "typical" exposures in routine applications and from "extreme" exposures (that is, the highest doses likely in routine applications). Worker and public "accidental" doses were also estimated for a series of possible accidents, such as being directly sprayed by an aircraft or spilling insecticide concentrate on unprotected skin. These doses were estimated to cover the whole range of possible program insecticide exposures. Both estimated and laboratory dose levels were expressed on a daily basis as milligrams of insecticide per kilogram of body weight per day (mg/kg/day).

The risk assessment was conservative because the assumptions used in estimating the doses used the highest value from the range of a number of variables. For example, although wind speed during the actual applications will vary from calm to 10 mph, the typical public dose was assumed to occur with a person standing 100 feet downwind from a cotton field that is being aerially sprayed in a 10-mph wind, leading to an insecticide deposition of about 4 percent of the on-the-field rate on

2 square feet of the person's exposed skin. The extreme estimate had the person standing 25 feet from the field in the same wind conditions, and the drift amounted to about 11 percent of the onsite rate. Accidental exposures involving dermal exposure assume that the exposed individual does not wash after being exposed but allows the insecticide to be absorbed. The risk assessment was also conservative in judging potential toxic effects because it compared the estimated doses to repeated human and rat doses that produced no effects, even though doses to the public should only occur rarely.

The risk assessment evaluated general systemic effects, such as cholinesterase inhibition, as well as effects on reproduction by comparing estimated doses to the no-observed-effect levels (NOELs) in laboratory animal reproduction studies. A margin of safety (MOS) was computed for each type of exposure by dividing the laboratory NOELs for systemic and reproductive effects by the estimated exposure. For example, if the NOEL is 25 mg/kg/day and the estimated dose is 0.1 mg/kg/day, the MOS is 250. A safety factor of 10 is usually applied for assessing risk from human studies, and an additional safety factor of 10 is usually applied for judging risk from laboratory animal studies.

For all calculations except systemic risks based on the human volunteer studies on malathion, exposures resulting in MOSs greater than 100 are assumed to present a negligible risk to human health. An MOS between 50 and 100 represents a slight risk. An MOS between 10 and 50 indicates a slight to moderate risk. If the MOS is between 1 and 10, there is a moderate to significant potential for adverse health effects. In the case of systemic risks based on human studies, EPA recommends using an uncertainty factor of 10, except for methyl parathion as discussed below. Therefore, in this risk assessment for malathion, an MOS equal to or greater than 10 represents a negligible risk, an MOS between 1 and 10 represents a moderate risk, and an MOS less than 1 is a significant risk. EPA recommends an uncertainty factor of 100 for the human studies on methyl parathion, so the MOS for risk evaluation is set at 100 for that chemical. Both malathion and methyl parathion were also evaluated in long-term feeding studies on rats. The NOELs from those studies are also listed in the human health risk tables. An MOS of 100 would be applied in these cases to indicate acceptable risk. Where an estimated dose exceeds a NOEL, the ratio is reversed and a minus sign added to give a "negative" margin of safety. A –MOS indicates a high probability of the risk of toxic effects.

Because a metabolite of malathion, malaoxon, has shown evidence of producing thyroid tumors in rats and diflubenzuron has shown evidence of producing lymph tumors in mice, a human cancer risk assessment was done for these two chemicals. This portion of the risk assessment took an estimate of the lifetime daily dose in mg/kg/day of the program insecticide (total of expected program doses divided by days in a 70-year lifetime) and multiplied it by the cancer potency of

the chemical (expressed as per mg/kg/day) as determined from the laboratory tumor data. This provided a number between 0 and 1 that indicated the chances of developing cancer from that lifetime exposure. For example, if the estimated average lifetime dose is 0.0002 mg/kg/day and the cancer potency is 0.005 per mg/kg/day, the risk of developing cancer is 0.000001, or 1 in 1 million. Risks of 1 in 1 million or less are assumed to be acceptable.

Table 4-1 lists the doses, NOELs, and computed MOSs for the public and workers from typical program exposures to malathion, methyl parathion, and diflubenzuron. Table 4-2 indicates the doses, NOELs, and computed MOSs for the public and workers from extreme program exposures. Table 4-3 shows doses, NOELs, and MOSs from various possible program accidents. Table 4-4 lists the control program lifetime cancer risks to workers and the public.

Public Health Risks

The risk assessment concluded that, in general, the program insecticides do not pose a risk to the public. Based on toxicity levels found in human studies on malathion and methyl parathion compared with expected "typical" program exposures, neither chemical is likely to cause health effects. Based on the results of studies in laboratory rats, however, methyl parathion does seem to pose a slight risk to anyone who consumes venison from a deer that has been exposed to insecticide drift and consumes diet items containing drift residues. Diflubenzuron poses no risk of public health effects under normal exposure circumstances.

Human studies indicate that malathion poses a moderate risk to the public of systemic effects from eating fish contaminated under the extreme scenario and that methyl parathion poses a significant and slight to moderate risk from eating fish and legumes, respectively.

Animal laboratory data suggest that under the extreme exposure scenario malathion and diflubenzuron pose a slight risk of systemic effects from eating fish from ponds that have received spray drift. Methyl parathion poses significant risk of systemic and reproductive effects from eating fish, and slight reproductive effects from eating berries that have received spray drift; slight to moderate risks of reproductive and systemic effects exist from eating legumes and venison, respectively, under the extreme scenario. In addition, MOSs calculated from laboratory animal NOELs indicate a similar risk of systemic effects from dermal exposure and inhalation of drift, and drinking water that has received drift under the extreme scenario. The laboratory animal studies further indicate that a moderate to significant risk of systemic effects may exist for those eating legumes and berries that receive drift from methyl parathion.

For malathion, human studies indicate that there are moderate risks of systemic effects as a result of being directly sprayed, drinking 2 liters of water from a 16-acre reservoir into which an accidental release of 80 gallons of malathion occurred, and eating legumes that were directly

Table 4-1. Estimated Doses and Margins of Safety for TYPICAL EXPOSURE to the Public and Workers in Alabama From Boll Weevil Insecticides

Exposure	Malathion (all doses in mg/kg/day)				Methyl parathion (all doses in mg/kg/day)				Diflubenzuron (all doses in mg/kg/day)			
	Estimate of exposure	Human NOEL[a] (MOS)	Rat NOEL[b] (MOS)	Repro. NOEL[c] (MOS)	Estimate of exposure	Human NOEL[d] (MOS)	Rat NOEL[e] (MOS)	Repro. NOEL[f] (MOS)	Estimate of exposure	Human NOEL[g] (MOS)	Rat NOEL[h] (MOS)	Repro. NOEL[i] (MOS)
Public:												
Dermal/inhalation	0.00000	0.23 (10,000)[j]	5.0 (10,000)[j]	25 (10,000)[j]	0.000000	0.31 (10,000)	0.025 (10,000)	0.25 (10,000)	0.00000	N/A	1.0 (10,000)	>8.0 (10,000)
Dietary: Water	0.0000703	0.23 (3,272)	5.0 (10,000)	25 (10,000)	0.0000281	0.31 (10,000)	0.025 (889)	0.25 (10,000)	0.00000937	N/A	1.0 (10,000)	>8.0 (10,000)
Fish	0.0000434	0.23 (5,305)	5.0 (10,000)	25 (10,000)	0.0000	0.31 (10,000)	0.025 (10,000)	0.25 (10,000)	0.00000	N/A	1.0 (10,000)	>8.0 (10,000)
Venison	0.000978	0.23 (235)	5.0 (5,112)	25 (10,000)	0.000461	0.31 (672)	0.025 (60)	0.25 (601)	0.000104	N/A	1.0 (9,615)	>8.0 (10,000)
Legumes	0.000306	0.23 (751)	5.0 (10,000)	25 (10,000)	0.000122	0.31 (2,540)	0.025 (204)	0.25 (2,042)	0.0000408	N/A	1.0 (10,000)	>8.0 (10,000)
Berries	0.000153	0.23 (1,503)	5.0 (10,000)	25 (10,000)	0.0000612	0.31 (5,065)	0.025 (408)	0.25 (4,083)	0.0000204	N/A	1.0 (10,000)	>8.0 (10,000)
Workers: Pilot	0.000453	0.23 (507)	5.0 (10,000)	25 (10,000)	0.00225	0.31 (138)	0.025 (11)	0.25 (111)	0.000561	N/A	1.0 (1,782)	>8.0 (10,000)
Mixer/loader	0.01	0.23 (23)	5.0 (500)	25 (2,500)	0.00479	0.31 (65)	0.025 (5)	0.25 (50)	0.00124	N/A	1.0 (804)	>8.0 (6,583)
Observer	0.0651	0.23 (4)	5.0 (77)	25 (384)	0.00279	0.31 (111)	0.025 (-1)	0.25 (9)	0.00698	N/A	1.0 (2,463)	>8.0 (1,146)
Monitoring team	0.0651	0.23 (4)	5.0 (72)	25 (384)	0.00279	0.31 (111)	0.025 (-1)	0.25 (9)	0.00698	N/A	1.0 (2,463)	>8.0 (1,146)
Hiboy operator	0.142	0.23 (2)	5.0 (35)	25 (176)	0.173	0.31 (2)	0.025 (-7)	0.25 (-1)	0.173	N/A	1.0 (6)	>8.0 (46)
Mist blower operator	0.124	0.23 (2)	5.0 (40)	25 (202)	0.126	0.31 (3)	0.025 (-5)	0.25 (2)	0.113	N/A	1.0 (9)	>8.0 (71)

[a] Source: EPA, 1988b.
[b] Source: EPA, 1988b.
[c] Source: EPA, 1988d.
[d] Source: EPA, 1987.
[e] Source: EPA, 1988d.
[f] Source: EPA, 1988g.
[g] No studies of diflubenzuron in humans were available.
[h] Source: EPA, 1988b.
[i] Source: EPA, 1988a.
[j] Where a MOS equals or exceeds 10,000, the value 10,000 is placed in the table.

Table 4-2. Estimated Doses and Margins of Safety for EXTREME EXPOSURE to the Public and Workers in Alabama From Boll Weevil Insecticides

Exposure	Malathion (all doses in mg/kg/day)				Methyl parathion (all doses in mg/kg/day)				Diflubenzuron (all doses in mg/kg/day)			
	Estimate of exposure	Human NOEL[a] (MOS)	Rat NOEL[b] (MOS)	Repro. NOEL[c] (MOS)	Estimate of exposure	Human NOEL[d] (MOS)	Rat NOEL[e] (MOS)	Repro. NOEL[f] (MOS)	Estimate of exposure	Human NOEL[g] (MOS)	Rat NOEL[h] (MOS)	Repro. NOEL[i] (MOS)
Public:												
Dermal/ inhalation	0.00292	0.23 (79)	5.0 (1,712)	25 (8,566)	0.00127	0.31 (244)	0.025 (20)	0.25 (197)	0.000330	N/A	1.0 (3,029)	>8.0 (10,000)
Dietary:												
Water	0.00351	0.23 (66)	5.0 (1,424)	25 (7,131)	0.00150	0.31 (206)	0.025 (17)	0.25 (167)	0.000375	N/A	1.0 (2,667)	>8.0 (10,000)
Fish	0.0594	0.23 (4)	5.0 (84)	25 (421)	0.512	0.31 (-2)	0.025 (-20)	0.25 (-2)	0.0164	N/A	1.0 (61)	>8.0 (488)
Venison	0.00179	0.23 (129)	5.0 (279)	25 (10,000)	0.000728	0.31 (426)	0.025 (34)	0.25 (343)	0.000182	N/A	1.0 (5,494)	>8.0 (10,000)
Legumes	0.0153	0.23 (15)	5.0 (327)	25 (1,638)	0.00653	0.31 (47)	0.025 (4)	0.25 (38)	0.00163	N/A	1.0 (613)	>8.0 (10,000)
Berries	0.00763	0.23 (30)	5.0 (655)	25 (3,275)	0.000327	0.31 (948)	0.025 (8)	0.25 (77)	0.000816	N/A	1.0 (1,225)	>8.0 (10,000)
Workers:												
Pilot	0.00979	0.23 (23)	5.0 (511)	25 (2,552)	0.00486	0.31 (36)	0.025 (5)	0.25 (51)	0.00122	N/A	1.0 (823)	>8.0 (6,583)
Mixer/loader	0.0295	0.23 (8)	5.0 (169)	25 (848)	0.0147	0.31 (21)	0.025 (2)	0.25 (17)	0.00367	N/A	1.0 (272)	>8.0 (2,179)
Observer	0.509	0.23 (-2)	5.0 (10)	25 (49)	0.255	0.31 (1)	0.025 (-10)	0.25 (-1)	0.0638	N/A	1.0 (6)	>8.0 (125)
Monitoring team	0.509	0.23 (-2)	5.0 (10)	25 (49)	0.255	0.31 (1)	0.025 (-10)	0.25 (-1)	0.0638	N/A	1.0 (6)	>8.0 (125)
Hiboy operator	1.13	0.23 (-5)	5.0 (4)	25 (22)	1.38	0.31 (-5)	0.025 (-55)	0.25 (-6)	1.38	N/A	1.0 (-1)	>8.0 (6)
Mist blower operator	0.249	0.23 (-1)	5.0 (20)	25 (100)	0.266	0.31 (1)	0.025 (-11)	0.25 (-1)	0.246	N/A	1.0 (4)	>8.0 (33)

[a] Source: EPA, 1988b.
[b] Source: EPA, 1988b.
[c] Source: EPA, 1988d.
[d] Source: EPA, 1987.
[e] Source: EPA, 1988a.
[f] Source: EPA, 1988g.
[g] No studies of diflubenzuron in humans were available.
[h] Source: EPA, 1988b.
[i] Source: EPA, 1988a.

Table 4-3. Estimated Doses and Margins of Safety for ACCIDENTAL EXPOSURE to the Public and Workers in Alabama From Boll Weevil Insecticides

Exposure	Malathion (all doses in mg/kg/day)				Methyl parathion (all doses in mg/kg/day)				Diflubenzuron (all doses in mg/kg/day)			
	Estimate of exposure	Human NOEL[a] (MOS)	Rat NOEL[b] (MOS)	Repro. NOEL[c] (MOS)	Estimate of exposure	Human NOEL[d] (MOS)	Rat NOEL[e] (MOS)	Repro. NOEL[f] (MOS)	Estimate of exposure	Human NOEL[g] (MOS)	Rat NOEL[h] (MOS)	Repro. NOEL[i] (MOS)
Accidents:												
Spill of concentrate	242.0	0.23 (-1,050)	5.0 (-48)	25 (-10)	63.3	0.31 (-204)	0.025 (-2,533)	0.25 (-253)	66.2	N/A	1.0 (-66)	>8.0 (-8)
Broken hose	242.0	0.23 (-1,050)	5.0 (-48)	25 (-10)	31.7	0.31 (-102)	0.025 (-1,267)	0.25 (-127)	16.5	N/A	1.0 (-17)	>8.0 (-2)
Immediate field entry	0.000350	0.23 (656)	5.0 (10,000)	25 (10,000)	0.000472	0.31 (657)	0.025 (58)	0.25 (585)	0.000427	N/A	1.0 (2,340)	>8.0 (10,000)
Direct spray—adult	0.0372	0.23 (6)	5.0 (134)	25 (850)	0.0180	0.31 (17)	0.025 (2)	0.25 (17)	0.00450	N/A	1.0 (265)	>8.0 (2,122)
Drinking reservoir water/release	0.0744	0.23 (3)	5.0 (67)	25 (336)	0.00800	0.31 (39)	0.025 (3)	0.25 (31)	0.00418	N/A	1.0 (222)	>8.0 (1,779)
Eating berries—direct spray	0.0139	0.23 (16)	5.0 (373)	25 (1,793)	0.000571	0.31 (54)	0.025 (4)	0.25 (44)	0.00143	N/A	1.0 (700)	>8.0 (5,600)
Eating legumes—direct spray	0.0279	0.23 (8)	5.0 (179)	25 (897)	0.0114	0.31 (27)	0.025 (2)	0.25 (22)	0.00286	N/A	1.0 (350)	>8.0 (2,800)

[a] Source: EPA, 1988b.
[b] Source: EPA, 1988b.
[c] Source: EPA, 1988d.
[d] Source: EPA, 1987.
[e] Source: EPA, 1988a.
[f] Source: EPA, 1988g.
[g] No studies of diflubenzuron in humans were available.
[h] Source: EPA, 1988b.
[i] Source: EPA, 1988a.

Table 4-4. Control Program Lifetime Cancer Risks

Exposure scenario	Risk	
	Malathion[a]	Diflubenzuron[b]
Public:		
Dermal and inhalation:		
Drift	0.0000000228	0.0000000118
Dietary:		
Water	0.00000000323	0.00000000164
Fish	0.000000299	0.0000000409
Venison	0.00000000826	0.00000000398
Legumes	0.000000107	0.0000000525
Berries	0.000000537	0.0000000263
Workers:		
Pilot	0.00000456	0.00000118
Aerial Mixer/loader	0.0000108	0.00000279
Observer/environmental monitoring team	0.0000490	0.0000550
Hiboy operator	0.000217	0.000550
Mist blower operator	0.000123	0.000237
Accidents:		
Spill of concentrate	0.0000481	0.0000603
Broken hose	0.0000481	0.0000241
Immediate field reentry	0.0000000000516	0.000000000287
Direct spray—adult	0.00000000420	0.00000000250
Direct reservoir water/release	0.0000000110	0.00000000281
Eating berries—direct spray	0.00000000197	0.000000000961
Eating legumes—direct spray	0.00000000394	0.00000000192

[a] Cancer risks are based on a cancer potency value of 0.00376 $(mg/kg/day)^{-1}$.
[b] Cancer risks are based on a cancer potency value of 0.01718 $(mg/kg/day)^{-1}$.
The carcinogenicity information on diflubenzuron is inconclusive; however, because positive results were obtained in one study, a cancer risk analysis was conducted.

Note: Risk calculations assume typical exposure 90 percent of the time and extreme exposure 10 percent of the time.

sprayed. The risks of reproductive effects from malathion to members of the public from all accident scenarios are negligible. For diflubenzuron, risks to the public of systemic and reproductive effects as a result of accidents are also negligible. Human studies of methyl parathion exposure indicate a slight to moderate risk from being directly sprayed, drinking water from a contaminated reservoir, and eating legumes that were directly sprayed. Eating berries that have been directly sprayed with methyl parathion poses a slight risk.

Rat studies indicate a slight risk of systemic effects from drinking water that received an accidental spill of malathion. Animal studies of methyl parathion exposure indicate that there are moderate to significant risks of systemic effects and slight to moderate risks of reproductive effects

from being directly sprayed, drinking water from a 16-acre reservoir contaminated by an accidental release, and eating berries or legumes that were directly sprayed.

Cancer risks to members of the public were evaluated to be less than 1 in 1 million for all exposures from malathion or diflubenzuron. Therefore, negligible cancer risks to the public are expected to result from public exposure to these insecticides as a result of the boll weevil control program in Alabama.

Worker Health Risks

Risks to workers who are routinely involved in program insecticide applications are understandably higher. Based on effect levels seen in human studies, malathion seems to pose a moderate risk to observers, monitoring teams, and hiboy and mist blower applicators in routine applications. Methyl parathion presents a slight risk to mixer/loaders and a moderate to significant risk to hiboy and mist blower operators. Based on a rat study, malathion poses a slight risk to observers and monitoring teams and slight to moderate risks to hiboy and mist blower operators. Methyl parathion poses a slight to moderate risk to pilots, mixer/loaders, and significant risks to observers/monitoring team, and hiboy and mist blower operators. Based on a rat study, diflubenzuron also presents a moderate to significant risk to hiboy and mist blower operators.

Reproductive risks to workers as a result of typical exposures to malathion are negligible. There are slight to moderate and slight risks of reproductive effects from typical exposures to diflubenzuron for hiboy and mist blower operators, respectively. Typical exposures to methyl parathion pose a moderate to significant risk of reproductive effects to mist blower operators and to observer/environmental monitoring team workers and significant risks of reproductive effects to hiboy and mist blower operators. Reproductive risks to mixer/loaders are slight to moderate for methyl parathion.

Based on effect levels determined in human studies, extreme exposures to malathion present a significant risk of systemic effects to observer/environmental monitoring team workers, and hiboy and mist blower operators, and a moderate risk to mixer/loaders. Methyl parathion presents a slight to moderate risk of systemic effects to pilots and mixer/loaders. It also presents a moderate to significant risk to observer/monitoring team members and to mist blower operators, as well as a significant risk to hiboy operators.

Based on effect levels determined in rat studies, extreme exposures to malathion indicate a moderate to significant risk of systemic effects to observers, monitoring team workers, and hiboy operators. There is a slight to moderate risk to mist blower operators. Also, rat studies indicate significant risks of systemic effects to observer/monitoring team workers and hiboy and mist blower operators from methyl parathion exposure. MOSs for methyl parathion indicate moderate to significant risks of systemic effects to pilots and mixer/loaders.

Extreme exposures to diflubenzuron pose a moderate to significant risk to observer/monitoring team workers and mist blower operators, and a significant risk to hiboy operators.

The MOSs for malathion indicate slight to moderate reproductive effects for observers, monitoring teams, and hiboy operators; mist blower operators are at slight risk. MOSs for diflubenzuron indicate slight to moderate and moderate to significant reproductive effects for mist blower and hiboy operators, respectively. MOSs for methyl parathion indicate a significant risk of reproductive effects to observer/environmental monitoring team workers and hiboy and mist blower operators, a slight risk to pilots, and a slight to moderate risk to mixer/loaders.

Malathion, diflubenzuron, and methyl parathion present significant systemic and reproductive risks from a spill of concentrate on the skin or spray from a broken hose. Additionally, methyl parathion poses a slight risk of systemic effects from immediate reentry to a treated area.

Malathion presents a cancer risk to hiboy and mist blower operators of about 2 in 10,000 and 1 in 10,000, respectively. Cancer risks to observer/environmental monitoring team workers, mixer/loaders, and pilots are 5 in 100,000, 1 in 100,000, and 5 in 1 million, respectively. Cancer risk also exceeds 1 in 1 million for exposure to diflubenzuron in hiboy operators (5 in 10,000), mist blower operators (2 in 10,000), mixer/loaders (3 in 1 million), pilots (1.2 in 1 million), and observer/environmental monitoring team workers (6 in 10,000). All other workers have potential cancer risks of less than 1 in 1 million. Accidental exposures to workers can also result in elevated cancer risk probabilities. Risks from malathion are about 5 in 100,000 for a spill of concentrate or spray from a broken hose. Estimated cancer probabilities as a result of diflubenzuron exposure are 6 in 100,000 for a spill of concentrate on the skin and 2 in 100,000 for being sprayed from a broken hose. For both insecticides, cancer risks are less than 1 in 1 million for immediate reentry to a treated area.

Mitigation Measures To Protect Human Health

The public seems to be at some level of risk from program applications of methyl parathion. Measures to mitigate this risk are presented in table 2-1 of the EIS.

Workers following label directions and standard operating procedures for insecticide applications are generally well protected from the extreme and accidental exposures evaluated here. Hiboy and mist blower operators who seem to be at the greatest risk would be adequately protected if they work only in a closed-system, air-conditioned cab.

Economics

Economic Impacts

This section describes the potential direct and indirect economic impacts of implementing the cooperative control program in central and northern Alabama.

Direct Impacts

Alabama depends on agriculture and related industries for employment and revenues (section 3, "Economics"). The direct economic impacts of the proposed eradication program in Alabama consist of increased employment and sales of treatment materials. The subsequent increase in personal incomes and revenues would benefit the economy of the State if the employees and needed materials are acquired within Alabama.

Mist blower and hiboy operators, trappers, field unit supervisors, air operations personnel, and Plant Protection and Quarantine (PPQ) officers will be required for the control program in central and northern Alabama. A total of 707 jobs should be available for residents, some of whom would otherwise be unemployed (table 4-5). The payroll from these positions during the 2½-year active eradication phase and 1-year post-eradication surveillance is estimated to be approximately $19 million. The contractor responsible for aerial pesticide application provides all the required labor, and although the contractors are usually local residents, this may not always be the case.

Expenditures for the pesticide, traps (including stakes, kill strips, and pheromone chips), and reimbursable mileage are estimated at $15 million over the 3½-year program. All equipment used in the program is owned by the Federal Government, so it is unlikely that any major capital expenditures would be made within the State as a result of the program. However, any replacement parts required for repairs and fuel would be purchased in Alabama; the value of these expenditures cannot easily be approximated.

Indirect Impacts

Each year between 1981 and 1984, Alabama cotton growers spent an average of $54.48 per harvested acre to control boll weevil and *Heliothis* spp. During that period, the average annual cost of controlling all cotton insects and mites was $65.32 per harvested acre.

Eradicating the boll weevil in Alabama is expected to decrease the cost of producing cotton by decreasing expenditures for cotton insecticides used to control the boll weevil and secondary pests. The non-Federal share of the projected cost of expanding the program in Alabama should be less than $25 per acre. The amount the grower actually pays can be reduced by funding from other non-Federal sources.

After eradication, the non-Federal share of program costs would likely be reduced to less than $10 per acre. Compared with the previous cost of controlling the boll weevil, this should result in the potential for increasing grower profits. Such an increase in profit could lead to a 20-to 25-percent increase in cotton acreage, replacing soybeans or corn (Smith, 1990). Insecticide costs have been reduced and yields increased as a result of boll weevil eradication elsewhere in the Southeastern

Table 4-5. Potential Employment Opportunities

Job categories	Central	North	Total
Mist blower operators	22	45	67
Hiboy operators	3	8	11
Trappers	105	223	328
Field unit supervisors	22	45	67
Air operations	63	129	192
Clerical	50	15	
Miscellaneous	229	478	27
Total	229	478	707

United States. In North and South Carolina insecticide savings are $29 per acre, and yield has increased 69 pounds per acre (USDA, 1989).

The long-term effects of an increase in cotton production include reductions in the market price of cotton lint, seed, cottonseed oil, and reduction of the government support price (NRC, 1981). New jobs may also become available in cotton-related industries, such as harvesting (pickers and balers), processing (cotton gins), and textile industries.

Socioeconomic Impacts

The boll weevil control program could have direct and indirect impacts on the social conditions and attitudes in Alabama. Direct impacts could occur if a grower's sense of well-being or economic security were affected by eradication. Indirect effects could occur as a result of economic outcomes of eradication. For example, reactions to the increase in cotton production and job availability are social effects derived from economic impacts. All of these impacts, direct and indirect, could affect lifestyles and community stability.

An earlier subsection described the direct impacts of the control program on employment and personal income. The economic impacts on individuals who obtain jobs or profit from the sale of materials would be the same wherever they live. Social effects, however, would depend on whether the jobs and profits gained were concentrated or dispersed throughout small or large communities. For example, the gain of 100 jobs scattered around the larger cities of Alabama would not have significant social effects. In contrast, if those 100 jobs were concentrated in two small towns with a combined labor force of 500, there would be significant social impacts on the two communities. The jobs available as a result of the control program would be scattered throughout the small towns of central and northern Alabama.

Residents of the small rural communities where cotton is grown provide all the labor necessary for cotton production and related local industries. The unemployment rate is higher in these rural areas than in the rest of Alabama (section 3), so any employment opportunities

resulting from the central and northern control program would be important to those communities.

Many of the social effects of the eradication program may occur as a result of increases in jobs and personal income. Compared with Alabama's total employment and total personal income, employment and income changes resulting from the control program in central and northern Alabama may seem small. However, if considered on a local basis, these changes may be important to individuals who rely on the continued productivity of cotton and employment in related industries for their livelihood.

Opposition to the Program

The decision to implement the control program in central and northern Alabama would ultimately be made by the growers' approval of the program by grower referendums. Passage of the referendums in the rest of the State depends on the growers' conviction that the program will work and that it is worth the cost.

Some growers who believe they can control the boll weevil on their fields for less than the cost of the program may be opposed to its implementation in central and northern Alabama. In some cases the growers' current annual control costs may be less than an annual grower assessment required by the national program. However, after the program has eradicated the boll weevil, grower control costs for the boll weevil should be eliminated. Without the program, the growers will continue to incur direct and indirect costs for boll weevil control each and every year.

Growers could also be opposed to the program if they perceive that a portion of their control over their cotton crop is being taken from them and given to the Federal Government. This opposition may be reduced by the fact that all program activities conducted on the farms will be performed by local residents employed by the program.

Public opposition to implementation of the program is likely to be most intense in rural communities or areas closest to cotton fields but could also occur in more distant areas. Whenever these issues arise, they will be considered on a local level. Appropriate public participation and other information efforts would likely mitigate any possible negative social effects.

Costs of Boll Weevil Controls

This section describes the methodology and assumptions used to estimate the costs of implementing the next increment of the control program in central and northern Alabama (table 4-6). The materials, equipment, and labor requirements for program expansion are presented, along with the costs of each. These costs are estimates based on expected resource requirements; actual costs would depend on other factors that cannot be predicted, such as the weather, actual boll weevil densities, and changes in material and labor costs. All costs are based

Table 4-6. Estimated Boll Weevil Eradication Costs[a] in Central and Northern Alabama

Category	Central Alabama		Northern Alabama[b]		Total
	Total costs	Costs per acre	Total costs	Costs per acre	
Personnel	$6,498,320	$64.13	$12,283,642	$50.54	$18,781,962
Pesticide	3,409,050	33.64	4,813,006	19.80	8,222,056
Aerial application	2,315,227	22.85	3,256,855	13.40	5,572,082
Traps/lures	1,208,613	11.93	2,786,424	11.46	3,995,037
Other	2,563,729	25.30	5,689,085	23.41	8,252,814
Total	$15,994,939	$157.85	$28,829,012	$118.61	$44,823,951
Non-Federal share (70%)	$11,196,457	$110.50	$20,180,308	$83.03	$31,376,765
Federal share (30%)	$4,798,482	$47.35	$8,648,704	$35.58	$13,447,185

[a] Assumes an annual rate of inflation of 4.1 percent in 1991 and 1992.
[b] Total costs for northern Alabama include adjacent program areas in Tennessee and Georgia.

on the current costs of the southern Alabama eradication program and allow for an annual rate of inflation of 4.1 percent. It is assumed that the Federal share of program costs will remain at 30 percent.

The control program in central and northern Alabama would consist of an active eradication phase and posteradication surveillance. It is expected to continue for a total of 3½ years—an initial fall diapause treatment followed by 2 full years of active treatment in both areas of the State and 1 year of post-eradication surveillance.

Chemical Control and Trap Surveying

The insecticides proposed for use in central and northern Alabama are malathion, diflubenzuron, and methyl parathion. The total cost of chemical control consists of the cost of insecticides, contracts for the aerial application of the insecticides (including aircraft, pilots, and mixer/ loaders), and wages associated with monitoring and ground application.

The program would begin in the late summer in both central and northern Alabama. It is expected that an average of eight diapause treatments would be applied to up to 80 percent of the cotton acreage in central Alabama, and an average of four treatments would be applied to up to 60 percent of the cotton in northern Alabama (table 4-7). Some trapping will be done before and during this period.

The overall density of trapping would increase the following spring to an average of one trap per 1 to 2 acres. Treatments would be applied

Table 4-7. Average Insecticide Treatment Schedule

Year	Central Alabama		Northern Alabama	
	Number of treatments	Percent of acreage	Number of treatments	Percent of acreage
1—Fall	8	80	4	60
2—Spring	4	25	2	20
2—Summer	4	8	4	5
2—Fall	8	35	6	30
3—Spring	3	10	3	7
3—Summer	4	5	4	2
3—Fall	8	20	6	15
4—Confirmation period	2	5	2	5

during the growing season when the designated threshold for boll weevils is exceeded. These treatments will control boll weevil reproduction and prevent economic damage to the crop. Fall diapause treatments would again be applied, where needed, to significantly reduce the overwintering boll weevil population. During the 2½-year eradication effort, one of the most intense periods will be during September of the first year. Although most fields may require treatment at this time, the percentage of fields treated will decrease rapidly with each treatment cycle. Growers will be offered incentives for early harvest and stalk destruction. Cooler temperatures in October will accelerate harvesting operations and allow longer treatment intervals. These factors will contribute to a continual decrease in the percentage of fields treated from one treatment cycle to the next.

During this period, the effect of rainfall is expected to be minimal. Appreciable rainfall does not usually occur until later in November and December after diapause treatments and harvesting. In northern Alabama, more than 95 percent of the cotton crop is harvested by late October.

During the season, cotton acreage may be treated aerially using fixed-wing aircraft or with ground equipment. The edges of the fields are trimmed aerially whenever possible. However, when the edges are obstructed by trees, power lines, or buildings or are near sensitive areas, such as the habitats of endangered or threatened species, the pesticide would be applied using a mist blower mounted on the back of a truck. Approximately 2 percent of the cotton acreage in central or

northern Alabama could not be treated aerially because of physical obstructions or proximity to sensitive areas; a hiboy tractor or mist blower would be used to treat these acres.

Aerial Application and Mist Blower Trim. The 55-gallon barrels of malathion used for aerial and mist blower application in southern Alabama cost approximately $15.50 per gallon, or $1.94 per acre. This figure assumes an application rate of 16 ounces per acre; 1 gallon will treat 8 acres. Although diflubenzuron and methyl parathion may be used in the program, the pesticide costs for the next increment of the program in central and northern Alabama are based on the current cost of malathion because it is the only pesticide used in southern Alabama and is expected to be used in central and northern Alabama. As noted in the discussion of national boll weevil control costs found in the EIS, based on bids received from chemical companies, the per acre cost of methyl parathion was only slightly less than for malathion. In addition, diflubenzuron is generally more than twice as expensive as methyl parathion or malathion. If diflubenzuron is used in Alabama, it would only be used two to four times in June.

The quantity of pesticide applied aerially is calculated on the total acreage of the field plus 5 percent for trim. Contract application of malathion costs approximately $10.53 per gallon, and the cost of the chemical plus application is approximately $3.40 per acre, including the 5 percent for trim. The contractor provides the aircraft, pilots, and ground crew. The salaries and benefits of personnel monitoring the aerial applications are estimated at $0.06 per acre per application. (Reimbursable mileage for these personnel are included in "Other Control Costs.")

Mist Blower Trim. Because the edges of some of the aerially treated cotton acreage are inaccessible by air, they will be trimmed by a mist blower mounted on the back of a truck rather than by aircraft. The acreage of these areas is estimated to be approximately 10 percent of the aerially treated acres. This percentage is equivalent to the proportion of an average 35-acre square field that could be treated by a 40-foot swath around the perimeter.

The total cost of the pesticide ($1.94 per acre) and the labor cost of application ($2.78 per acre) add up to $4.72 per acre. The pesticide cost would be the same as for aerial application. The cost of the mist blower operator is calculated on an 8-hour workday, 5 days a week for 28 weeks, at a wage rate of $6.20 per hour. One mist blower operator would be required for each 5,000 acres of cotton trimmed using this equipment. The mist blowers and trucks are owned by the Federal government.

Ground Application With Hiboys. In Alabama about 2 percent of the cotton acreage requiring treatment each season would be treated using only ground equipment. The cost of the pesticide and labor is estimated at $4.08 per acre ($2.00 per acre for pesticide and $2.08 per acre

for the hiboy operator). The 5-gallon barrels of malathion RTU used for hiboy application cost $16.00 per gallon; 1 gallon will treat 8 acres. The hiboy tractors are owned by the Federal Government. The $2.08 per acre cost of the hiboy operators is based on each operator working 6 hours per day, 5 days per week for 28 weeks, at a wage rate of $6.20 per hour. One hiboy operator would be needed for each 1,000 to 1,500 acres of cotton not treated by aircraft.

Trap Surveying. During the active phase of the program, traps used to estimate population densities would be placed every 100 to 125 feet along a field's perimeter and every 200 feet at the open ends of the field, for an average of one trap per acre.

A complete pheromone trap costs approximately $1.11 to $0.90 for the trap, $0.02 for the kill strip, $0.10 for the pheromone chip, and $0.09 for the stake. The kill strip will last all season, but the pheromone chip must be replaced every 2 weeks from mid-May until mid-November (10 times during the growing season). The per acre cost for the pheromone ($1.00 each season) is estimated separately from the cost for the rest of the trap ($1.01 per acre) because approximately 30 percent of the traps are damaged by farm equipment or are dislodged from the stake and lost in the field each year and must be replaced. In addition, exposure to weather limits the traps' durability to 12 months in the fields or two growing seasons. At the end of each season, most of the traps would be collected and stored until the following spring.

One trapper would generally be hired for every 1,000 acres of cotton planted. Trappers work from early April until the end of November and earn $180 per week their first year and $200 per week in subsequent years. The cost per acre for this 28-week period, assuming half of the trappers are experienced and half are new, would be $5.32. An additional $2.50 per acre would be incurred for mileage reimbursement.

Other Control Costs

Other incurred expenses are not directly attributable to a treatment method. These program costs include USDA personnel, travel, relocation costs, utilities, services, repairs, supplies, and field unit supervisors (one for each 5,000 acres of cotton).

Post-eradication Surveillance

During the post-eradication phase, there would be one trap every 10 acres or two traps per field, whichever is greater. Trap costs at an average density of one trap every 7 acres would be $0.14 per acre. Replacement of the pheromone chips 10 times during the growing season would cost an additional $0.14 per acre. Monitoring costs are estimated to be $5 per acre per year, including travel. In addition, one PPQ officer might be employed for every 80,000 acres to supervise the trapping and communicate with cooperators each season. At a General

Schedule level 9/5 ($28,001 annually), this is equivalent to $0.12 per acre.

Cultural Resources

The next increment of the eradication program in Alabama is not expected to have an impact on cultural resources. Cultural artifacts that may have existed on farm land have already been disturbed, removed, or destroyed by farming practices so the program treatments would not have any additional impact. There may be an increase in acres planted in cotton as a result of eradication. However, these additional acres are expected to result from the conversion of land already cleared and devoted to other crops, according to a personal communication with Smith (1990). No new clearing of land is expected; therefore, undiscovered cultural resources would not be disturbed.

Pesticide applications should not affect nearby cultural sites, such as the prehistoric Indian mounds or historic plantation homes described in section 3. The three counties with the greatest number of sites listed on the National Register of Historic Places—Montgomery, Jefferson, and Mobile—produce relatively little cotton (fig. 3-14 of this appendix). Aircraft used by the program are small and, if flying over a cultural site en route to a cotton field, would be at altitudes (as required by the Federal Aviation Administration—1,000 feet above any obstacle in congested areas, 500 feet above any structure in noncongested areas) high enough to avoid any disturbing noise.

Visual Resources

The fluorescent green traps used in monitoring boll weevil populations may be visually unappealing and distracting to some people.

Also, there may be a temporary increase in the visibility of agricultural airplanes for spray operations because some areas now treated by growers with ground equipment might be treated aerially. However, the sight of agricultural aircraft is common in Alabama's rural areas. In several years, the program will eliminate the need for aerial pesticide treatments for the boll weevil.

Air Quality

Pesticide treatments in central and northern Alabama require ground equipment and aircraft that emit pollutants. Total emission levels from each source are likely to change in the next increment because some acres that growers treat with ground equipment might be treated aerially. This increase in aerial emissions would be offset by the decrease in ground equipment emissions to some degree, so it is not expected to significantly affect Alabama's air quality. All areas not meeting Federal standards for regulated air pollutants in 1989 were in urban areas (section 3).

Malathion has an odor that may offend anyone near a sprayed cotton field. However, malathion used in the next increment should not result in any significant additional impacts because some growers in the region already use it, the odor dissipates a short time after application, and the people likely to be near enough to a cotton field to smell it would be growers and others accustomed to the smell.

Noise

Noise from farm machinery and pesticide application equipment is a common sound in the agricultural areas of Alabama. Therefore, no additional noise impacts are expected in the next increment.

Energy Requirements and Conservation Potential

Fuel use in the next increment of the program will result from transporting personnel, materials, and equipment to a treatment area. Fuel is also used by aircraft and other equipment during the treatments. The principal fuels used are gasoline, diesel fuel, and aviation fuel.

With the program, there is a greater potential to conserve fuel than with existing grower practices. More acreage would probably be treated aerially at one time, as opposed to treating the acreage at each separate grower's request. This would reduce the trips to and from the airport and thereby reduce the airplanes' fuel requirements. Also, the ULV method of application used by the program allows pilots to treat more acres per hour of aircraft operation.

Section 5

Conclusions

This section discusses the general conclusions reached in the site-specific analysis of the impacts from implementing the National Boll Weevil Cooperative Control Program in Alabama. This discussion analyzes the conclusions in terms of the choice of insecticide for particular locations and circumstances and in terms of the certainty about whether specified impacts would occur.

Choice of Program Insecticide

As with any selection in treatment materials, each of the three insecticides analyzed for boll weevil control in Alabama—diflubenzuron, malathion, or methyl parathion—has its strengths and limitations.

Diflubenzuron

Diflubenzuron, an insect growth regulator, has low toxicities for mammals, fish, birds, honey bees, and most biological control agents. However, it is highly toxic to aquatic invertebrates, such as crayfish. Exposed members of the public and wildlife species are at low risk from its use. Aerial applicators are at low risk, but high doses would put ground applicators at risk.

Diflubenzuron is effective in early-season boll weevil treatments, but it must be applied repeatedly and followed by an organophosphate treatment. Diflubenzuron could be used for early-season applications, where aquatic habitats are not immediately adjacent to the cotton fields.

Malathion

Malathion, an organophosphate, is more toxic to mammals and birds than diflubenzuron, but it is less toxic than the highly toxic methyl parathion. Exposed members of the public and wildlife species are at low risk from its use. Aerial applicators are at low risk, but ground applicators are likely to be at risk from high doses. Malathion is toxic to honey bees, so precautions must be taken to protect commercial hives. Malathion also poses a significant risk to aquatic communities because it is highly toxic to fish species such as bass and bluegills, as well as amphibians and aquatic invertebrates.

Malathion is more likely to be used in the program than the other chemicals. Malathion could be used in early-season applications, where important aquatic habitats are not immediately adjacent to cotton fields. Malathion could also be used for mid- or late-season treatments.

Methyl Parathion

Methyl parathion, an organophosphate, is highly toxic to mammals, fish, birds, and honey bees. Although short-term studies in human volunteers have shown it to be no more toxic than malathion at doses of approximately 0.20 to 0.30 mg/kg/day, lifetime studies in rats have shown it to be about 80 times more toxic than malathion. The Environmental Protection Agency's (EPA) Reference Dose (RfD; the safe

lifetime daily dose) for methyl parathion, based on a rat study, is 0.00025 milligrams per kilogram per day (mg/kg/day), compared to a malathion RfD, based on a study in human volunteers, of 0.02 mg/kg/day. Exposed members of the public and wildlife species, aerial applicators, and ground applicators are at risk from its use. However, methyl parathion is far less toxic to fish and amphibians than malathion, although it is highly toxic to aquatic invertebrates.

Methyl parathion could be used in locations where particular fish or amphibian species require protection. Where endangered or threatened fish or amphibian species occur in the upper reaches of watersheds, it would afford adequate protection against possible toxic effects from drift or runoff in mid- or late-season treatments. Because cotton growers in Alabama now use methyl parathion routinely to control boll weevils, it would likely find universal acceptance as an alternative to diflubenzuron or malathion. Adequate precautions would have to be taken to prevent direct human or wildlife exposures. Those precautions would include limiting applications in some areas to ground equipment to prevent offsite drift; requiring applicators to operate only in closed, air-conditioned cabs with recirculating air; strictly adhering to protective clothing and laundering requirements; and notifying people near the treated fields.

Mitigation

Two mitigation practices would be the most appropriate and practical for reducing risk to aquatic habitats—using ground equipment near sensitive areas and monitoring local weather. Ground equipment minimizes possible drift into surface waters, but it does not prevent runoff. Weather monitoring would predict the few large rainstorms during the growing season that could cause significant contaminated runoff into surface waters. These storms should be predicted and treatments suspended at least 24 hours in advance. In northern Alabama, most large storms occur in early spring or winter, when pesticide treatments are not required.

Program Impacts Certain or Almost Certain To Occur

The program will certainly affect populations of beneficial insects in cotton fields treated with one of the program insecticides. Other insects and invertebrate species in and on the perimeter of the treated cotton fields will also be affected.

Workers in the program are certain to sustain a number of minor injuries; however, major injuries would be infrequent, and fatalities are unlikely. A few workers will have depressed cholinesterase levels from exposure to malathion or methyl parathion. Some are likely to experience at least low-level symptoms, such as headache or nausea. Proper precautions in handling and applying these chemicals and regular cholinesterase testing of program personnel and contract applicators would be critical to limit the possibility that any workers would become symptomatic.

Program Impacts That May Occur

Members of the public may be exposed to one of the program insecticides near treated cotton fields, and some may experience depressed cholinesterase levels. One or more may become symptomatic, particularly if exposed to methyl parathion, but no member of the public is expected to have serious acute effects or long-term health effects. Workers routinely involved with diflubenzuron or malathion may be at higher risk of contracting cancer than members of the general population. Ground applicators with repeated exposures to any of the program insecticides may also experience reproductive effects.

Wildlife or aquatic species may be exposed to one of the program insecticides near a treated cotton field. Some individuals may be seriously affected; one or more may die. Wildlife are at greatest risk from methyl parathion exposure, while fish and amphibian species are at greatest risk from malathion exposure. No significant population effects are expected. There is no reported evidence from the program in the 21 southern counties or from growers in the rest of the State of significant numbers of wildlife or aquatic species dying as a result of malathion or methyl parathion applications to cotton fields.

The State may experience minor economic impacts from the influx of Federal program monies, but any major impacts would most likely be confined to small rural communities in which the program would be a significant employer. There may be reaction in the grower community and in the general population based on concern about program costs or about the toxicity levels and human and environmental effects of the program insecticides.

The boll weevil and other cotton pests in Alabama may potentially develop insecticide resistance. The broader scale treatments in the program, as opposed to the more isolated treatments now being done by growers in the central and northern parts of the State, would subject the pest species to greater pressure to develop that resistance. Insecticide use of at least the proposed intensity in other program areas has not demonstrated insecticide resistance to be an important factor. In addition, the program is expected to be completed in approximately 3½ years, while current practices without the program would be expected to continue indefinitely.

Successful eradication of the boll weevil in Alabama should reduce the overall use of pesticides in cotton production in the State, reduce the amount of pesticides in the environment near the cotton fields, eliminate risks from the longer term use of organophosphates by the growers, and eliminate the early-season loss of beneficial insects and the resulting problems with secondary cotton pests. At that point, an integrated pest management program for the remaining cotton pests would be possible in Alabama.

Minor transitory effects on air quality and noise levels will occur during treatment, but no lasting effects are likely. Some minor damage

to plants on or immediately adjacent to treated fields may occur, but no plants are likely to be killed.

Program Impacts Certain or Almost Certain Not To Occur

The program is not expected to affect Alabama's geology, topography, or climate because the individual cotton fields are approximately 30 acres in size. The combined treated acreage is less than 1 percent of Alabama's total land surface. None of the physical actions that might affect these elements, such as widespread mining, earth moving, broad-scale use of fire, or risk of wildfires, are in any way a part of the program.

Impacts to soils are unlikely. The insecticides are short-lived in the environment and do not seem to affect soil organisms for any significant length of time. The insecticide applications and the machinery used for stalk destruction should not disturb the cotton field soils more than similar agricultural procedures already being used. The program should also have no effect on cultural resources.

Attachment A

Insecticide Fate Modeling and Risk Assessments

Introduction

This attachment describes how the Animal and Plant Health Inspection Service (APHIS) estimated the transport and fate of the program insecticides from their application to various components of the Alabama environment and the risks the components may experience from those exposures. The first section of this attachment discusses the computer models used to estimate airborne insecticide drift that may result if the wind carries the sprayed pesticide offsite. The model also estimates concentrations of pesticides in bodies of water receiving drifted insecticide or insecticide in rainwater running off the cotton fields after a storm. The second section estimates exposure to humans who may be exposed to the insecticides and evaluates the risks of toxic effects from those exposures. The last section estimates exposures that terrestrial wildlife and aquatic species may experience from being near a cotton field during a pesticide application or from being in a body of water that receives drift or runoff insecticide from a rainstorm.

Fate Modeling of Boll Weevil Program Insecticides

When released into the environment, chemical insecticides may enter aquatic systems by three main pathways. Drift from pesticide application equipment may land on neighboring streams and ponds. Runoff from fields may contain insecticide concentrations that enter streams and rivers. Finally, pesticides may leach into the ground with absorbed precipitation and enter groundwater resources. Mathematical models were used to predict the concentration of insecticide entering the aquatic environment in these ways. This analysis required use of the three different models described below.

The AGricultural DISPersion (AGDISP) simulation model is used to model the atmospheric transport of the insecticides as they are released from an aircraft used in the boll weevil program and the deposition of this drift on water surfaces. The Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model was chosen for its ability to predict the movement and degradation of pesticides in the plant-rooting zone and the migration of insecticides from the field through leaching and surface runoff. Finally, the EXposure Analysis Modeling System (EXAMS) II model was used in this analysis to predict the fate and transport of chemicals in aquatic environments. These models are described in detail in appendix B.

All three models require the assumption of a specific insecticide application rate. The application rates used for diflubenzuron, malathion, and methyl parathion were 0.125, 1.17, and 0.5 pounds active ingredient (a.i.) per acre (lb a.i./acre), respectively. The properties of the insecticides that determine their behavior in the environment are also an important factor in all three models. A discussion of the environmental

fate of the three insecticides considered in this analysis is included in appendix B.

Model Simulations

The AGricultural DISPersion Simulation Model

The AGDISP simulation model has been used to predict the drift of insecticides after they are released from application aircraft. A discussion of the assumptions made in the AGDISP simulation about aircraft characteristics, patterns of insecticide deposition, characteristics of pesticide application, and assumptions of meteorological conditions is provided in attachment B. Modeling methodology remained the same for this analysis. However, the simulation was rerun for this analysis to ensure that all results were normalized to a 1 lb a.i./acre application rate. The output of the simulation provided information about drift deposition rates as a function of distance from the field. Drift deposition at 25 and 100 feet for each insecticide is provided in table A-1.

The GLEAMS Model

The GLEAMS model was developed for field-size areas to evaluate the movement and degradation of chemicals within the plant-root zone under various crop management systems. A description of the components of the GLEAMS model itself and the input parameters requirements is included in attachment B. Some of the important insecticide parameters used in the GLEAMS modeling are listed in table A-2. The results of this model were manipulated to ascertain water quality effects of the program in headwater streams, farm ponds, and small watersheds. The results of the GLEAMS modeling were also used to determine insecticide mass loadings to the EXAMS II model.

Five representative sites were chosen for modeling, covering the range of soils and topography in Alabama cotton production areas. Although locations, soil types, and other factors may produce somewhat different results, the five scenarios modeled represent a range of typical conditions that, when combined with extreme precipitation patterns, can be expected to show potential for offsite insecticide movement by surface runoff or percolation through soil. The five representative site and soil combinations used were as follows:

- Northern Alabama, Decatur silt loam, flat slopes
- Central Alabama, Savannah loamy sand, flat slopes
- Central Alabama, Savannah loamy sand, steep slopes
- Central Alabama, Bigbee sand, flat slopes
- Central Alabama, Congaree loam, flat slopes

The typical soil types, site characteristics, and cotton management practices were chosen in consultation with research and extension personnel familiar with cotton management in each area. Most cotton in Alabama is grown in silt loam and sandy loam soils, such as Decatur and Savannah types. However, a part of the cotton fields may be in sand or loam soils. The Bigbee and Congaree soil types were examined

Table A-1. Estimated Maximum Agricultural Drift From Aircraft

Applied insecticide	Application rate (lb a.i./acre)	Deposition[a] (mg/m^2)	
		25 ft	100 ft
Diflubenzuron	0.125	8.0	0.2
Malathion	1.17	74.8	I.5
Methyl parathion	0.5	32.0	0.6

[a] Deposition determined from AGDISP model.

Table A-2. GLEAMS Chemical Parameters

Chemical	Water solubility (ppm)	Half life		K_{oc}	Washoff fraction	Uptake coefficient
		Foliar (days)	Soil (days)			
Diflubenzuron	0.2	27	9	6,790	0.05	1
Malathion	145.0	3	3	1,800	0.90	1
Methyl parathion	60.0	3	5	14,000	0.65	1

Note: K_{oc} = organic carbon partition coefficient; relates sorption properties to soil organic matter.

to determine the fate of insecticides over the range of possible growing conditions. Some of the more important input parameters for each site are listed in table A-3. The typical field size used in the simulations was 30 acres. The Soil Conservation Service runoff curve numbers shown in table A-3 are used to determine the amount of water that runs off from the land surface as a result of a given storm. The numbers were chosen to be realistic, but they represent moderately high runoff conditions.

The rainfall data were obtained for Huntsville and Selma, Alabama, from the National Climatic Data Center, Asheville, North Carolina. These climatic data files cover the periods from January 1, 1985, through September 1, 1988, for Huntsville; and January 1, 1985, through December 31, 1989, for Selma. Precipitation data for Huntsville were used for modeling the northern Alabama soils, and precipitation data for Selma were used for modeling the central Alabama soils. In addition to natural rainfall data, 2-year storm events (that is, for a given location, a storm of a size that occurs on the average only once every

Table A-3. Site Characteristics

Soil type	Saturated conductivity (in 1 hour)	SCS[a] runoff curve number	Soil erodibility	Surface porosity $\left(\frac{C^3}{C^3}\right)$	Surface organic matter (%)	Slope (ft/ft)
Decatur silt loam	0.22	75	0.35	0.43	1.0	0.01
Savannah sandy loam	0.22	78	0.35	0.36	1.5	0.01
Savannah sandy loam	0.22	78	0.35	0.36	1.5	0.05
Bigbee sand	0.35	67	0.15	0.40	1.0	0.01
Congaree loam	0.10	85	0.38	0.40	3.0	0.01

[a] Soil Conservation Service.

Source: USDA, 1984.

2 years) were added to the precipitation data files to simulate extreme situations. While 2-year storm events in almost all cases produced the greatest pesticide loss from the field, they did not necessarily produce the highest runoff concentration, due to smaller runoff volumes from smaller storms. Therefore, runoff from naturally occurring storms was also analyzed and concentrations were used in place of 2-year runoff concentrations when they represented a more extreme situation.

The GLEAMS model requires the user to determine the amount of applied insecticide assumed to be deposited on cotton foliage and the amount assumed to be deposited directly on the soil. This calculation was done based on the age, leaf surface area, and size of the cotton plants. The percentage of applied insecticide deposited on the cotton foliage ranged from 45 percent to 70 percent, with the remainder assumed to be deposited directly on the soil.

Two scenarios were evaluated with the GLEAMS model for each pesticide, using naturally occurring rainfall data, augmented with 2-year storm events. For each of the five site and soil combinations described above, the model was run for both a typical and extreme scenario for a field receiving a maximum application rate. For the typical scenario, the assumption was made that the insecticide was being applied on a 7-day interval schedule. For malathion and methyl parathion, a 2-year storm was added in late September, 2 days after the fourth application in the fall diapause schedule. For diflubenzuron, a 2-year storm was added in early July, 2 days after the fourth application in the diflubenzuron schedule. For the extreme scenario, it was assumed that malathion and methyl parathion were applied on a 3-day interval schedule in July or August. A 2-year storm was added to the

model 2 days after the third application in a series of applications on this interval. For diflubenzuron, the scenario used for the extreme situation was similar to that used for the typical situation. However, the 2-year storm was assumed to occur 1 day after the fourth application in the diflubenzuron schedule.

The results of GLEAMS were also manipulated to determine the concentration of insecticide in a farm pond following a runoff event. The analysis assumed that the farm pond had a surface area of 1 acre and collected runoff from 33 acres, 30 acres of which were treated cotton fields. The typical scenario was based on a storm occurring 2 days after a spray application during the heaviest application portion of the program. The extreme scenario for the runoff modeling consisted of insecticide application followed by sufficient rain to require a repeat treatment the following day, but not to cause significant runoff. The second application was followed by another storm the next day.

The EXAMS II Model

The simulation of insecticide concentrations for representative river basins was performed with EXAMS II, developed at the Athens Environmental Research Laboratory of the Environmental Protection Agency. EXAMS II is a set of mathematical models that simulate the most important factors that contribute to the degradation and transport of a chemical in an aquatic environment. Additional background on the modeling system is provided in appendix B.

The environments selected for modeling (fig. 3-7 in chapter 3) were the Alabama River Basin and the Tennessee River Basin. The Alabama River Basin was modeled from the Thurlow Dam on the Tallapoosa River downstream to the Claiborne Dam on the Alabama River. The Tennessee River Basin was modeled from the Guntersville Dam to the Wheeler Dam. Determination of main stream length, stream geometries, and streamflow were unaltered from the methodology used in appendix B. The physical and chemical parameters used as inputs to EXAMS II are given in table A-4. Pesticide characteristics, model inputs (with the exception of mass loadings), and model operation were also unaltered from the original methodology. Refer to appendix B for more detailed discussions of the model use and methodology.

The methodology for determining mass loadings to the compartments in the model remains similar to the procedure described in appendix B. However, two loading scenarios for the eradication program were examined in this analysis—a typical scenario and an extreme scenario. No loading scenarios were examined for the suppression alternative. The Tennessee River Basin was modeled assuming that all cotton was grown in relatively flat, silt loamy soils, such as Decatur soils. The Alabama River Basin was modeled assuming that all cotton was grown in relatively flat, loamy sand soils, such as Savannah soils.

Table A-4. EXAMS II Chemical Parameters

Chemical	Molecular weight (g/mol)	Vapor pressure (torr)	Organic carbon fraction K_{oc} (mg/kg/mg/L)	Water solubility (ppm)	Degradation rate constant (units/hour)
Diflubenzuron	311	0.000001	6,790	0.20	0.0204
Malathion	330	0.000125	1,800	145.0	0.00412
Methyl parathion	277	14.4	14,000	50.0	13.7

Note: K_{oc} = organic carbon partition coefficient; relates sorption properties to soil organic matter.

The scenarios for diflubenzuron and for malathion and methyl parathion were constructed differently, based on application patterns used for these insecticides. However, for all three insecticides, assumptions were made to facilitate the modeling of realistic typical and maximum situations.

For the typical scenario for diflubenzuron, a 2-year storm was added to the GLEAMS model 2 days after the last diflubenzuron treatment on a 7-day interval cycle. It was also assumed that a maximum of 60 percent of the fields would be treated during any given week. For the maximum scenario for diflubenzuron, an additional assumption was made. It was assumed that on the day of diflubenzuron application, a small storm event (0.5 inches) occurred that did not produce any runoff. The rain did, however, require respraying 20 percent of the fields the following day.

The typical and maximum scenarios for diflubenzuron runoff are based on the fact that there is a small window of opportunity for maximum efficacy and there may be time to respray fields because not all fields will require treatment. In the case of malathion or methyl parathion application, however, all fields in the watershed may require treatment. Therefore, respraying the fields because of washoff 1 day after an application would not be feasible.

Because of these conditions, the typical and maximum scenarios were constructed differently for malathion and methyl parathion. It was assumed that all fields in the watershed would be sprayed over a consecutive 3-day period during the first diapause. It was determined that the maximum pesticide residues would be available for loss from the field following the fourth week of application during the fall diapause period. This was calculated based on the half-lives of the insecticides and the cotton harvesting schedule. For a typical scenario, a 2-year storm was added 2 days after the third consecutive day of treatments (after 100 percent of the fields in the watershed had been

sprayed). For a maximum scenario, a 2-year storm was added 1 day after the third consecutive day of treatments. Pesticide loadings to each segment were computed based on cotton grown in the drainage area and the results produced by GLEAMS modeling of the two scenarios described above. The determination of mass loading to each compartment is the same as in appendix B and the methodology used is described there as well.

Surface Water Quality

If surface water resource quality is affected by the program, the effects are expected to be short term. All of the insecticides considered for use in the program degrade rapidly and will quickly disappear from the aquatic environment and soils once the program spraying has been completed. In general, insecticide concentrations will be highest in aquatic environments adjacent to sprayed fields, such as farm ponds and small streams, and decrease with further distance downstream in the watershed. This pattern is caused by increased water volumes available for dilution of the dissolved insecticide, as drainage and rapid degradation of the proposed program insecticides increases.

The GLEAMS model was used to analyze pesticide concentrations in water and soil runoff from a field. This situation represents an extreme condition that is only present until the field runoff enters a live stream or pond. At that point, the concentrations will be reduced as dilution of the insecticide occurs. Tables A-5 and A-6 present the concentrations of insecticide in water and soil runoff coming directly off the field, assuming that a storm occurred 2 days after a heavy pesticide application. Losses of insecticide from leaching are not expected to occur in any soils; therefore, they do not appear on these tables. When the sands were modeled, no significant runoff occurred from any of the large storms. The concentrations of insecticides in runoff water from the sandy loams and silt loams do not vary greatly. The insecticide concentrations in the runoff from the loam soils are generally lower, because of the larger amounts of runoff water from the loam fields.

Several parameters not evaluated in GLEAMS serve to reduce the potential of cotton field runoff reaching surface water. Runoff from agricultural fields is sometimes collected in drainage ditches, especially in areas where water is a scarce commodity and irrigation is used to water crops. Fallow vegetation around cotton fields also tends to prevent insecticide-laden runoff from reaching surface water. The vegetation retains runoff sediment and adsorbs some insecticides in solution.

A farm pond scenario was also examined in this analysis. This scenario was considered important because of the farm pond's proximity to spraying operations and its accessibility to human, wildlife, and domestic animal populations. Because the surface area of a pond is large compared to the surface area of drainage ditches and streams, the effects of drift and runoff on farm pond water quality were examined. Table A-7 presents the results of computations based on drift from a field with a buffer (from the pond edge to the cotton field edge) of

Table A-5. Predicted Pesticide Losses for 2-Year Storm: Runoff Water and Eroded Soil Under the TYPICAL Application Schedule for the Beltwide Eradication Program[a]

Site/soil	Diflubenzuron		Malathion		Methyl parathion	
	Water (mg/L)	Soil (µg/g)	Water (mg/L)	Soil (µg/g)	Water (mg/L)	Soil (µg/g)
Decatur silt loam (1% slopes)	0.0194	1.3119	0.3391	6.1217	0.0570	8.0003
Savannah sandy loam (1% slopes)	0.0137	2.2835	0.2107	9.3384	0.0316	10.8812
Savannah sandy loam (5% slopes)	0.0137	2.3608	0.2107	9.6587	0.0385	13.7157
Bigbee sand (1% slopes)	0.0172	7.0503	0.1750	18.9977	0.0529	44.6418
Congaree loam (1% slopes)	0.0089	2.4111	0.1895	13.5807	0.0218	12.1465

[a] This scenario assumes that pesticides are being applied at 7-day intervals and that a 2-year storm occurs 2 days after a pesticide application. For diflubenzuron, the model storm occurs in early July; for malathion and methyl parathion, the model storm occurs in early October during the fourth week of diapause treatments.

Table A-6. Predicted Pesticide Losses for Model Storm: Runoff Water and Eroded Soil Under the MAXIMUM Application Schedule for the Beltwide Eradication Program[a]

Site/soil	Diflubenzuron		Malathion		Methyl parathion	
	Water (mg/L)	Soil (µg/g)	Water (mg/L)	Soil (µg/g)	Water (mg/L)	Soil (µg/g)
Decatur silt loam (1% slopes)	0.0208	1.3938	0.3904	6.9984	0.0617	8.6021
Savannah sandy loam (1% slopes)	0.0149	2.4854	0.4129	18.0751	0.0662	22.5225
Savannah sandy loam (5% slopes)	0.0149	2.5693	0.4129	18.7575	0.0662	23.3727
Bigbee sand (1% slopes)	0.0187	7.6588	0.3327	36.0866	0.0902	76.1184
Congaree loam (1% slopes)	0.0097	2.6336	0.3740	26.7225	0.0374	20.8025

Note: For diflubenzuron, this scenario assumes that the pesticide is being applied at 7-day intervals and that a 2-year storm occurs 1 day after the fourth application, which occurs in early July.

[a] For malathion and methyl parathion, this scenario assumes that pesticides are being applied at 3-day intervals and that a 2-year storm occurs 2 days after a pesticide application during late summer.

Table A-7. Farm Pond Water Concentrations for Several Scenarios for the Beltwide Eradication Program

Scenario	Diflubenzuron (mg/L)	Malathion (mg/L)	Methyl parathion (mg/L)
Direct spray	0.00929	0.0870	0.0372
Extreme runoff	0.00483	0.168	0.0306
Typical runoff	0.00261	0.0455	0.00946
Drift onto pond with a 25-foot buffer	0.00123	0.0115	0.00492
Drift onto pond with a 100-foot buffer	0.000741	0.00693	0.00296

100 feet, drift from a field with a buffer of 25 feet, runoff from a field, and a direct spray of the pond surface. The direct spray scenario assumed that a single swath was flown across the pond surface and that all pesticide drift from the swath landed in the pond. The concentrations determined in both runoff scenarios were below those present in direct runoff from a field, because of the dilution of the runoff by the pond water.

The field runoff and farm pond scenarios represent the areas where the greatest concentrations of insecticides in the aquatic environment are expected. The larger rivers represent areas where the concentrations of insecticides will be significantly lower. Lower concentrations are expected because of the greater volume of water available for dilution and degradation of insecticides over time. The EXAMS II modeling estimated the riverine concentration of insecticides under the proposed eradication programs for typical and extreme scenarios. Since the GLEAMS model predicted no leaching and thus no groundwater transport of insecticides from treated cotton fields, the only portion of insecticide contributed in EXAMS II was from surface water flow. Tables A-8 and A-9 illustrate the maximum predicted river concentrations in any compartment after 7 days of the modeled storm for the two river basins modeled. Because a steady-state loading of the insecticides was assumed, the highest concentrations are found on day 7 of the precipitation event. Maximum insecticide concentrations in the modeled rivers were several orders of magnitude lower than maximum insecticide concentrations leaving the cotton fields.

The peak concentrations presented in tables A-8 and A-9 are representative of only part of the modeled river. Dissolved concentrations of methyl parathion and diflubenzuron in the Alabama River peaked just upstream of Montgomery and steadily declined to less than 5 percent of the peak at the Claiborne Dam, the downstream end of the study segment (see fig. 3-8, appendix I). Dissolved levels of malathion were within 10 percent of the maximum concentration from Montgomery

Table A-8. Maximum Predicted Insecticide Concentrations in the ALABAMA RIVER 7 Days After a Model Storm Under the Typical and Maximum Scenarios for the Beltwide Eradication Program

Element	Typical scenario			Maximum scenario		
	Diflubenzuron	Malathion	Methyl parathion	Diflubenzuron	Malathion	Methyl parathion
Water:						
Total (mg/L)	0.00000326	0.00168	0.000263	0.00000503	0.00206	0.000307
Dissolved (mg/L)	0.00000324	0.00167	0.000262	0.00000501	0.00206	0.000306
Sediments (mg/kg)	0.000110	0.0151	0.0183	0.000170	0.0186	0.0214
Biota (mg/g)	0.00949	1.47	0.0973	0.0147	1.81	0.114
Sediments:						
Total (mg/L)	0.00000824	0.00234	0.00395	0.0000127	0.00288	0.00462
Dissolved (mg/L)	0.000000225	0.000231	0.0000558	0.000000348	0.000284	0.0000652
Sediments (mg/kg)	0.00000764	0.00207	0.00391	0.0000118	0.00255	0.00457
Biota (mg/g)	0.000659	0.202	0.0208	0.00102	0.249	0.0242

Table A-9. Maximum Period Insecticide Concentrations in the TENNESSEE RIVER 7 Days After a Model Storm Under the Typical and Maximum Scenarios for the Beltwide Eradication Program

Element	Typical scenario			Maximum scenario		
	Diflubenzuron	Malathion	Methyl parathion	Diflubenzuron	Malathion	Methyl parathion
Water:						
Total (mg/L)	0.00000126	0.000358	0.0000586	0.00000150	0.000401	0.0000668
Dissolved (mg/L)	0.000000126	0.000358	0.0000584	0.00000149	0.000400	0.0000665
Sediments (mg/kg)	0.000426	0.00322	0.00409	0.000507	0.00360	0.00466
Biota (mg/g)	0.0367	0.314	0.0217	0.0437	0.351	0.0247
Sediments:						
Total (mg/L)	0.0000320	0.000573	0.000884	0.0000381	0.000640	0.00101
Dissolved (mg/L)	0.000000875	0.0000564	0.0000125	0.00000104	0.0000631	0.0000142
Sediments (mg/kg)	0.0000297	0.000508	0.000874	0.0000353	0.000568	0.000996
Biota (mg/g)	0.00256	0.0495	0.00464	0.00304	0.0554	0.00528

downstream to the southern boundary of Dallas County. This segment of the river corresponds to the highest cotton production areas in the watershed. At the downstream end of the modeled segment, however, malathion concentrations are less than 50 percent of the peak. In the Tennessee River Basin, concentrations of all three insecticides peaked near Huntsville, which corresponds to the only section of the modeled segment that is not part of a reservoir. Concentrations of all insecticides drop sharply as the river enters Wheeler Reservoir. Concentrations were elevated again just upstream of the Wheeler Dam as the Elk River enters the reservoir. However, the concentrations in this second peak for malathion, methyl parathion, and diflubenzuron are 50 percent, 20 percent, and 30 percent of the upstream peak concentrations. Concentrations drop off sharply for all three insecticides at Wheeler Dam, the downstream end of the study segment.

This analysis examined insecticide concentrations from the environments where the highest concentrations would be expected—direct field runoff and farm ponds—to environments where much lower concentrations would be expected—rivers and reservoirs. Aquatic environments downstream of cotton production fields will exhibit insecticide concentrations below those found in aquatic environments adjacent to fields. It would be misleading to derive numbers for these situations because so many variables affect insecticide concentrations on a site-by-site basis. However, it is reasonable to assume that the variables in these situations will produce a range of insecticide concentrations, ranging from undiluted field runoff down to negligible levels, depending on the specific site and upstream conditions.

Results from the GLEAMS modeling were also used to examine potential residues of the insecticides that remain in the field soil. The results of this analysis indicate that for all insecticides and all representative soil types, no cumulative buildup of residues in the soil is expected. In each year of the program, the maximum buildup of residues occurs at the end of the maximum application period and decreases rapidly. While Bigbee sand exhibited residual pesticide longer than the other soils, no insecticide was present in any soils when the next application year began.

Groundwater Quality

The GLEAMS model output provided information on the potential of insecticides to leach below the root zone and possibly into the groundwater. The rooting depth for cotton was assumed to be 40 inches (100 cm). Leaching potentials of diflubenzuron, malathion, and methyl parathion were evaluated at all five representative sites. The modeling results indicate that percolation through the soil (even during extreme storm events) is negligible and no pesticide percolated through the root zone.

Tables A-10 and A-11 illustrate the distribution of leached insecticide residues in Decatur silt loam and Savannah sandy loam after a 2-year storm during the heaviest application period for typical and maximum application scenarios. None of the insecticides reached a depth of more

Table A-10. Pesticide Concentration (in parts per million) in DECATUR SILT LOAM After a 2-Year Storm During the Maximum Application Period

Northern Alabama	Depth of soil (cm)				
	0-1	1-16	16-33	33-50	50-67
	Average scenario used in GLEAMS model:				
Diflubenzuron	0.6281	0.0105	0.0000	0.0000	0.0000
Malathion	5.4191	0.4963	0.0162	0.0004	0.0000
Methyl parathion	3.2383	0.0267	0.0000	0.0000	0.0000
	Maximum scenario used in GLEAMS model:				
Diflubenzuron	0.6693	0.0121	0.0001	0.0000	0.0000
Malathion	6.1423	0.4134	0.0074	0.0000	0.0000
Methyl parathion	3.4805	0.0218	0.0001	0.0000	0.0000

Table A-11. Pesticide Concentration (in parts per million) in SAVANNAH SANDY LOAM After a 2-Year Storm During the Maximum Application Period

Central Alabama	Depth of soil (cm)				
	0-1	1-16	16-33	33-50	50-67
	Average scenario used in GLEAMS model:				
Diflubenzuron	0.5870	0.0068	0.0000	0.0000	0.0000
Malathion	3.8223	0.1514	0.0023	0.0000	0.0000
Methyl parathion	2.4874	0.0103	0.0000	0.0000	0.0000
	Maximum scenario used in GLEAMS model:				
Diflubenzuron	0.6390	0.0076	0.0000	0.0000	0.0000
Malathion	7.4650	0.3203	0.0048	0.0000	0.0000
Methyl parathion	5.2094	0.0238	0.0000	0.0000	0.0000

than 20 inches (50 cm) in the Decatur silt loam and Savannah sandy loam soils. The insecticide leaching in Bigbee sand was also examined. Although a small quantity of malathion may leach to a 20-inch depth (50 cm) in these sands, no malathion leached below the root zone. In all soils studied, malathion accumulated to the highest concentration in soils and migrated farthest downward although it never reached the groundwater in significant quantities. As discussed previously, all of the insecticides readily degrade. They also are readily adsorbed to the soil. Based on these two processes and on the results of the GLEAMS modeling, none of the insecticides should reach the groundwater in any significant amount.

The Alabama Department of Environmental Management and the Alabama Department of Agriculture and Industries are conducting a groundwater monitoring study, the results of which will be used in developing a groundwater protection strategy for pesticide use in Alabama. The monitoring for Phase I of this study was completed in 1989. This phase sampled 50 private wells in 10 counties to determine occurrences of pesticides in groundwater. Each well was sampled in early May, late June or early July, and mid-August. In the 150 samples taken, only 1 sample contained a detectable concentration of malathion of 0.09 parts per billion (ppb). This well was located in Colbert County. No diflubenzuron or methyl parathion was detected in any samples. Phase II of this program is currently sampling additional wells in each county sampled in Phase I. An additional phase of the study may involve the installation of monitoring wells adjacent to cotton fields for a more complete picture of pesticide fate.

Human Exposure and Risk Assessment

This section summarizes the human health risk assessment of potential adverse effects to workers or members of the public that may result from using the insecticides malathion, diflubenzuron, and methyl parathion in the boll weevil control program in Alabama. Detailed information on laboratory toxicity studies, environmental fate and transport modeling methodology, and exposure analysis methodology is available in appendix B of the final EIS.

The risk assessment consists of four parts: (1) a hazard analysis that examines the toxic effects of each chemical in humans and laboratory animals to determine toxicity reference levels; (2) a model of the environmental fate and transport to determine the levels of insecticide residue that may be present in various elements of the environment; (3) an exposure analysis, in which insecticide doses from several scenarios to workers and members of the public are estimated; and (4) a risk analysis, in which the toxicity reference levels are compared to the dose estimates. This allows the characterization of potential risks to individuals that may be exposed to the insecticides as a result of the boll weevil control program in Alabama.

Refer to appendix B for information on the toxicity and environmental fate of the insecticides, qualitative discussions of the risk of mutagenic effects, and information on the risks to sensitive individuals.

Hazard Analysis

The toxicity reference levels used in this risk analysis are summarized in table A-12. Based on a review of the toxicity of the insecticides, no-observed-effect levels (NOELs) were determined for each compound for general systemic, reproductive, and developmental health effects. NOELs are doses, in milligrams of chemical per kilogram of body weight per day (mg/kg/day), at which no adverse effects are observed in laboratory studies. In the studies in which NOELs were determined, adverse effects were present at the next highest dose level, with the exception of the study on which the reproductive NOEL for diflubenzuron is based. No effects were noted at the highest dose tested in this study. Therefore, the true threshold for reproductive

Table A-12. Toxicity Levels Used in This Analysis

Insecticide	Systemic NOEL (mg/kg/day)		Reproductive NOEL (mg/kg/day)	Cancer potency $(mg/kg/day)^{-1}$
	Rat	Human		
Malathion	5.0	0.23	25.0	0.00376
Diflubenzuron	1.0	—[a]	>8.0[b]	0.01718[c]
Methyl parathion	0.025	0.31	0.025	NA[d]

[a] — = not available.
[b] This reproductive NOEL is based on the highest dose tested; therefore, it may overestimate risk.
[c] The carcinogenicity information on diflubenzuron is inconclusive; however, because positive results were obtained in one study, a cancer risk analysis was conducted.
[d] NA = Not applicable.

effects from diflubenzuron may be much greater than the NOEL used in this analysis. The systemic and reproductive NOELs used in this risk assessment are summarized in table A-12.

For the insecticides that have given any indication in laboratory studies of potential carcinogenicity (malathion and diflubenzuron), cancer potency factors were identified. These factors represent the probability, averaged over a lifetime, that a tumor will result from exposure to 1 mg/kg/day of the compound. Cancer potency factors are presented in units of probability per mg/kg/day, or $(mg/kg/day)^{-1}$, and are summarized in table A-12. Although these compounds are not necessarily proven carcinogens, the conservative nature of this risk assessment makes a cancer risk analysis appropriate for insecticides where a positive response has been noted.

Environmental Fate and Transport

In this risk analysis, the computer simulation AGDISP was used to predict the drift of insecticides after release from the application aircraft. This simulation takes into account the application rate, aircraft and spray system characteristics, formulation, meteorology, release height, canopy characteristics, and topography. The results of the simulation are incorporated into the exposure analysis. These estimates of surface deposition and airborne concentrations are used to calculate doses for members of the public and workers who may have dermal or inhalation exposure to airborne spray drift, dermal exposure to vegetation with drift residues, or ingestion exposure from contaminated water or food items containing drift residues.

Runoff from treated fields was also evaluated, using the computer model GLEAMS to estimate the concentrations of pesticides in water flowing off a field. The scenario for the runoff modeling consisted of insecticide application, followed by only enough rain to require a repeat treatment the following day but not enough to cause significant runoff. The second application was followed by a storm that generated the

maximum runoff insecticide concentration seen in the model. Resulting water concentrations in the ponds receiving runoff were incorporated into the risk analysis as extreme doses.

Exposure Analysis

The application rates of the insecticides proposed for use in the Alabama boll weevil control program are summarized in table A-13.

There are several categories of workers in the Alabama program. Pilots fly the planes during aerial applications of insecticide. Mixer/loaders load insecticide into the plane's tank by connecting a hose from the storage tank to the plane's tank; a single mixer/loader would do this approximately three times per day. No flaggers are involved in aerial insecticide applications in Alabama. However, one worker acts as a combined observer and environmental monitor who sets out dye cards to evaluate drift, observes the aerial application, and later collects the dye cards. Ground-based insecticide applications are conducted using either a hiboy tractor with a boom or a mist blower.

Table A-13. Chemical Treatment Application Rates

Insecticide	Application rate (lb a.i./acre)
Malathion	1.17
Diflubenzuron	0.125
Methyl parathion	0.50

The hiboy operator and assistant refill the equipment approximately three times per day while the mist blower operator refills the mist blower every four days. The hours per day and days per year worked by workers in each category are summarized in table A-14.

Members of the public may also be exposed to the boll weevil control insecticides. This may happen through dermal or inhalation exposure to insecticide spray drift or consumption of water or food items that are contaminated with insecticide residues.

Accidental exposures may affect workers or members of the public. These include actions such as an accidental spill of insecticide onto the skin, immediate reentry to a treated area, direct spray of a person, accidental release of insecticide into drinking water, or direct spray of food items that are later consumed.

Estimated typical, extreme, and accidental doses to workers and members of the public are summarized in tables A-15, A-16, and A-17 for exposures to malathion, diflubenzuron, and methyl parathion.

Table A-14. Insecticide Application Workers and Exposure Times

Worker	Hours per day		Days per year	
	Typical	Extreme	Malathion and methyl parathion	Diflubenzuron
Pilot	6	10	140	25
Aerial mixer/loader	0.75	2	140	25
Observer/environmental monitoring crew:				
Year 1	8	12	140	25
Year 2	8	12	70	12
Year 3	8	12	28	5
Ground equipment operators:				
Hiboy operator:				
Applying				
Year 1	6	10	140	25
Year 2	6	10	70	13
Year 3	6	10	70	13
Mixing/loading				
Year 1	0.5	1	140	25
Year 2	0.5	1	70	13
Year 3	0.5	1	70	13
Mist blower operator:				
Applying				
Year 1	8	12	140	25
Year 2	8	12	70	12
Year 3	8	12	28	5
Mixing/loading				
Year 1	0.2	0.2	56	10
Year 2	0.2	0.2	28	5
Year 3	0.2	0.2	7	3

Risk Analysis

Estimation of Systemic and Reproductive Risks

To quantify the risks of general systemic and reproductive/developmental health effects, estimated doses were compared to laboratory NOELs. The ratio between the NOEL and the estimated human dose is called the margin of safety (MOS). For example, a NOEL of 20 mg/kg/day divided by a dose of 0.2 mg/kg/day results in an MOS of 100. This margin of safety approach is used to compensate for the inherent uncertainty in extrapolating a dose-response relationship from studies in laboratory animals to human health risks and to allow for the variation in sensitivity among the human population. A factor of 10 is allowed for each of these uncertainties, resulting in an MOS of 10 × 10, or 100, that is recognized as unlikely to result in adverse effects in

Table A-15. Control Program Exposures to MALATHION

Exposure scenario	Dose (mg/kg/day)	
	Typical	Extreme
Public[a]:		
Dermal and inhalation:		
Drift	0.00000	0.00292
Dietary:		
Water	0.0000703	0.00351
Fish	0.0000434	0.0568
Venison	0.000978	0.00171
Legumes	0.000306	0.0153
Berries	0.000153	0.00763
Workers[b]:		
Pilot	0.000453	0.00939
Aerial mixer/loader	0.0096	0.0283
Observer/environmental monitoring team	0.0651	0.509
Hiboy operator	0.142	1.13
Mist blower operator	0.123	0.247
Accidents:		
Spill of concentrate		242.0
Broken hose		242.0
Immediate field reentry		0.000350
Direct spray—adult		0.0294
Drinking reservoir water/release		0.0744
Eating berries—direct spray		0.0134
Eating legumes—direct spray		0.0267

[a] Public exposures: typical at 100 feet, extreme at 25 feet.
[b] Worker exposures: typical is based on average dose; extreme is based on upper 95 percent confidence level.

humans. For the systemic NOEL based on a study in humans on malathion, a MOS of 10 is considered sufficient. For the systemic NOEL based on a study in humans on methyl parathion, EPA recommends a MOS of 100. For the insecticide diflubenzuron, a true reproductive NOEL has not been determined because no effects were observed at the highest dose tested in any reproductive or developmental toxicity study using that insecticide. Therefore, the reproductive risk assessment for diflubenzuron may be overly conservative in estimating risks.

As the estimated dose to humans approaches the NOEL, the risk to humans increases. In this risk assessment when an estimated dose exceeds a NOEL, the ratio is reversed (that is, the dose is divided by the NOEL) and preceded by a minus sign to indicate the factor by which the dose exceeds the NOEL. An MOS of -10, for example, indicates that the dose is 10 times higher than the laboratory-

Table A-16. Control Program Exposures to DIFLUBENZURON

Exposure scenario	Dose (mg/kg/day)	
	Typical	Extreme
Public[a]:		
Dermal and inhalation:		
Drift	0.00000	0.000330
Dietary		
Water	0.00000937	0.000375
Fish	0.00000	0.0164
Venison	0.000104	0.000182
Legumes	0.0000408	0.00163
Berries	0.0000204	0.000816
Workers[b]:		
Pilot	0.000561	0.00122
Aerial mixer/loader	0.00124	0.00367
Observer/environmental monitoring team	0.00698	0.0638
Hiboy operator	0.173	1.38
Mist blower operator	0.113	0.246
Accidents:		
Spill of concentrate		66.2
Broken hose		16.5
Immediate field reentry		0.000427
Direct spray—adult		0.00450
Drinking reservoir water/release		0.00418
Eating berries—direct spray		0.00143
Eating legumes—direct spray		0.00286

[a] Public exposures: typical at 100 feet, extreme at 25 feet.
[b] Worker exposures: typical is based on average dose; extreme is based on upper 95 percent confidence level.

determined NOEL. If the dose equals the NOEL, there is a margin of safety of 1.

Although margins of safety less than 100 (or, for human studies, 10) are considered to present a risk of toxic effects, it should be noted that MOSs are based on a comparison with doses that produced no effects in laboratory animals, or humans. All NOELs used in this risk analysis are based on subchronic or chronic repeated exposures and are compared to doses that were calculated on a realistic basis, resulting in up to 140 daily exposures per year for workers or up to 10 daily exposures per year for members of the public. Comparing daily chronic NOELs to doses received on a less frequent basis may tend to overestimate the risks, especially those resulting from one-time exposures, such as accidents.

For comparisons to laboratory animal studies, exposures resulting in MOSs equal to or greater than 100 are assumed to present a negligible

Table A-17. Control Program Exposures to METHYL PARATHION

Exposure scenario	Dose (mg/kg/day)	
	Typical	Extreme
Public[a]:		
Dermal and inhalation:		
Drift	0.0000	0.00127
Dietary		
Water	0.0000281	0.00150
Fish	0.00000	0.512
Venison	0.000416	0.000728
Legumes	0.000122	0.00653
Berries	0.0000612	0.000327
Workers[b]:		
Pilot	0.00225	0.00486
Aerial mixer/loader	0.00497	0.0147
Observer/environmental monitoring team	0.00279	0.255
Hiboy operator	0.173	1.38
Mist blower operator	0.126	0.266
Accidents:		
Spill of concentrate		63.3
Broken hose		31.7
Immediate field reentry		0.000427
Direct spray—adult		0.0180
Drinking reservoir water/release		0.00800
Eating berries—direct spray		0.00571
Eating legumes—direct spray		0.0114

[a] Public exposures: typical at 500 and 100 feet, extreme at 100 and 25 feet.
[b] Worker exposures: typical is based on average dose; extreme is based on upper 95 percent confidence level.

risk to human health. If the MOS is between 50 and 100, this is described as a slight risk. An MOS between 10 and 50 is considered a slight to moderate risk, and if the MOS is less than 10, it is assumed that there is a moderate to significant potential for adverse health effects. MOSs less than 1 pose significant risks of adverse health effects. For comparison to human studies, MOSs equal to or greater than 10 are termed negligible, MOSs between 1 and 10 are described as presenting moderate risks, and MOSs less than 1 pose significant risks.

MOSs for risks to members of the public and workers from typical and extreme exposures are summarized in tables A-18 and A-19, respectively.

Estimation of Cancer Risks

A cancer risk analysis was conducted for malathion and diflubenzuron, based on the results of laboratory studies that suggest these insecticides

Table A-18. Summary of Risks to the Public and Workers From TYPICAL Exposures in the Boll Weevil Cooperative Control Program in Alabama

Insecticide	MOSs for systemic effects	MOSs for reproductive effects
Malathion	Based on human NOELs, all MOSs greater than 10 for the public.	All MOSs greater than 100 for the public.
	MOSs less than 10 for observer, monitoring team, and hiboy and mist blower operators.	All MOSs greater than 100 for workers.
	Based on rat NOELS, all MOSs are greater than 100 for the public. MOS less than 100 for observer and less than 50 hiboy and mist blower operators.	
Diflubenzuron[a]	Based on rat NOELs all MOSs greater than 100 for the public.	All MOSs greater than 100 for the public.
	MOSs less than 10 for hiboy and mist blower operators.	MOSs less than 50 for hiboy operator and less than 100 for mist blower operator.
Methyl parathion	Based on human NOELs, all MOSs greater than 100 for the public. MOS less than 100 for mixer/loaders and less than 10 for hiboy and mist blower operators.	
	Based on rat NOELs, MOSs less than 100 for consumption of venison from a deer that received spray drift and consumed contaminated diet items.	
	MOSs less than 50 for pilot and mixer/loader. MOS less than 10 for mixer/loader. Dose exceeds NOEL for observer/ monitoring team and hiboy and mist blower operators.	MOS 50 or less for mixer/loader. Less than 10 for observer/monitoring team and mist blower operator. MOSs less than 10 for hiboy operator.

[a] For reproductive MOSs from diflubenzuron, an MOS less than 100 may not necessarily indicate a risk of adverse effects, because the NOEL used in this analysis was the highest dose tested in any diflubenzuron reproductive toxicity study.

Note: MOSs greater than 100 (greater than 10 for systemic risks based on human studies for malathion) are considered acceptable levels of risk.

Table A-19. Summary of Risks to the Public and Workers From EXTREME Exposures in the Boll Weevil Cooperative Control Program in Alabama

Insecticide	MOSs for systemic effects	MOSs for reproductive effects
Malathion	Based on human NOELs, MOS less than 10 for consumption of fish from a pond that received drift at 25 feet.	
	MOS less than 10 for mixer/loader. Dose exceeds NOEL for hiboy and mist blower operators, and observer/monitoring team.	
	Based on rat NOELs, all MOSs less than 100 for consumption of fish.	MOSs for observer/EM team and hiboy operator less than 100.
	MOSs 10 or less for observer/monitoring team and hiboy operator. MOS less than 50 for mist blower operator.	
Diflubenzuron[a]	MOS less than 100 for consumption of fish from a pond that received drift at 25 feet.	All MOSs greater than 100 for the public.
	MOS less than 100 for observer/monitoring team and mist blower operator. Dose exceeds NOEL for hiboy operator.	MOS less than 50 for mist blower operator. MOS less than 10 for hiboy operator.
Methyl parathion	Based on human NOELs, MOSs for eating contaminated legumes less than 50, and less than 10 for eating fish from contaminated pond.	MOSs less than 50 and 100 for consumption of contaminated legumes and berries, respectively. Dose exceeds NOEL for consumption of fish from contaminated pond.
	MOSs less than 100 for pilot and mixer/loaders. MOSs less than 10 for observer/monitoring team and mist blower operator. MOS less than 1 for hiboy operator.	
	Based on rat NOELs, MOSs less than 100 for consumption of legumes or berries with drift residues, less than 50 for venison from a deer receiving drift at 25 feet and consuming diet containing drift at 25 feet, and for dermal and inhalation exposure to drift. MOS less than 10 for consumption of fish from pond receiving drift and berries or legumes with drift residue.	
	MOSs less than 10 for pilot and mixer/loader. Dose exceeds NOEL for hiboy and mist blower operators and observer/monitoring team.	MOS less than 100 for pilot and less than 50 for mixer/loader. Dose exceeds NOEL for hiboy and mist blower operators, and observer/EM team.

[a] For reproductive MOSs from diflubenzuron, an MOS less than 100 may not necessarily indicate a risk of adverse effects, because the NOEL used in this analysis was the highest dose tested in any diflubenzuron reproductive toxicity study.

Note: MOSs greater than 100 (greater than 10 for systemic risks based on human studies for malathion) are considered acceptable levels of risk.

may have the potential to cause cancer. Although the evidence is inconclusive in the case of diflubenzuron, a cancer risk analysis was appropriate in consideration of the conservative nature of this risk assessment. Methyl parathion does not appear to be carcinogenic based on laboratory animal study data.

The risk of cancer was calculated for an individual by averaging the estimated cumulative lifetime dose from the Alabama boll weevil control program over a 70-year life span and multiplying the result by the cancer potency factor for the insecticide. This calculation resulted in an estimated probability that cancer will occur at some point in the person's life as a result of the assumed exposures. In all cases, the duration of the control program in Alabama was assumed to be 3 years. The calculation of the lifetime dose to members of the public included the assumption that typical doses are received nine times per year and extreme doses are received once per year. Calculation of lifetime doses to workers incorporated the assumption that the worker receives a typical dose 90 percent of the time and an extreme dose 10 percent of the time.

Cancer risks of 1 in 1 million (1×10^{-6}) are considered to be acceptable risks, as they are generally thought to represent a negligible increase over the background cancer risk of approximately 1 in 4 that is present in the United States. One in 1 million is also commonly used by EPA as a point of departure in cancer risk analyses.

Cancer risks to members of the public and workers as a result of the boll weevil program in Alabama are summarized in table A-20.

Risks of Systemic and Reproductive Health Effects

Margins of safety for systemic and reproductive risks from typical, extreme, and accidental exposures to members of the public and workers are presented in tables A-21 through A-23. Moderate and significant risks are discussed in the following sections.

Risks to Members of the Public—Typical Exposures. Based on toxicity levels determined in human studies on malathion and methyl parathion, as compared with typical public exposures, neither insecticide is likely to cause health effects. Based on the results of studies in laboratory rats, however, methyl parathion may pose a slight risk to anyone who consumes venison from a deer that has been exposed to insecticide drift and consumes diet items containing drift residues. Diflubenzuron poses no risk of public health effects under typical exposure scenarios.

Risks to Members of the Public—Extreme Exposures. Based on toxicity levels determined in a human study, malathion poses a moderate risk of systemic effects from consuming fish from a pond receiving drift at 25 feet. When compared to the human study NOEL, MOSs for methyl parathion indicate significant risks of systemic and reproductive effects from consuming fish from a pond receiving drift at 25 feet, and a slight

Table A-20. Summary of Cancer Risks to the Public and Workers From the Boll Weevil Cooperative Control Program in Alabama

Insecticide	Risks to the public	Risks to workers
Malathion	Less than 1 in 1 million for all members of the public.	Seven in 1 million for hiboy operators and 5 in 1 million for mist blower operators.
Diflubenzuron[a]	Less than 1 in 1 million for all members of the public.	Seven in 1 million for hiboy operators and 4 in 1 million for mist blower operators.
Methyl parathion	There are insufficient toxicological data to assess the carcinogenicity of methyl parathion.	There are insufficient toxicological data to assess the carcinogenicity of methyl parathion.

[a] The carcinogenicity information on diflubenzuron is inconclusive. However, because positive results were obtained in one study, a cancer risk analysis was conducted.

Note: Cancer probabilities greater than 1 in 1 million are considered to present an unacceptable level of risk.

to moderate risk from consuming legumes receiving drift from 25 feet. When compared to the rat study NOEL, MOSs for methyl parathion indicate a slight to moderate risk of systemic effects from dermal and inhalation exposures at 25 feet, drinking water that contains drift residues from 25 feet, and consuming venison from a deer consuming diet items containing drift residues from 25 feet. MOSs for methyl parathion indicate significant risk of systemic and reproductive effects from consuming fish from a pond receiving drift residues at 25 feet. Consuming legumes or berries with drift residues 25 feet from a treated area poses a moderate to significant risk of systemic effects; there is a slight and a slight to moderate risk of reproductive effects from eating berries and legumes, respectively.

Risks to Members of the Public—Accidental Exposures. Accident scenarios for members of the public include direct exposure of an adult to aerial spray, consumption of legumes or berries that have been directly sprayed, and consumption of water from a reservoir that received an 80-gallon accidental spill of insecticide from an aircraft.

For malathion, there are moderate risks of systemic effects as a result of a direct spray, drinking 2 liters of water from a reservoir containing an accidental release of 80 gallons of malathion, and from eating legumes that were directly sprayed. Risks of reproductive effects from malathion to the public from all accident scenarios are negligible.

For diflubenzuron, risks of systemic or reproductive effects as a result of these accidents are negligible.

Table A-21. Control Program Margins of Safety for MALATHION

Exposure scenario	Systemic				Reproductive (Rat)	
	Typical		Extreme			
	Human	Rat	Human	Rat	Typical	Extreme
Public[a]:						
Dermal and inhalation:						
Drift	10,000	10,000	79	1,712	10,000	8,566
Dietary:						
Water	3,272	10,000	66	1,424	10,000	7,131
Fish	5,305	10,000	4	84	10,000	421
Venison	235	5,112	129	279	10,000	10,000
Legumes	751	10,000	15	327	10,000	1,638
Berries	1,503	10,000	30	655	10,000	3,275
Workers[b]:						
Pilot	507	10,000	23	511	10,000	2,552
Aerial mixer/loader	23	500	8	169	2,497	848
Observer/environmental monitoring team	4	77	-2	10	384	49
Hiboy operator	2	35	-5	4	177	22
Mist blower operator	2	40	-1	20	201	100
Accidents:						
Spill of concentrate			-1,050	-48		-10
Broken hose			-1,050	-48		-10
Immediate field reentry			656	10,000		10,000
Direct spray—adult			8	134		850
Drinking reservoir water/release			3	67		336
Eating berries—direct spray			16	373		1,793
Eating legumes—direct spray			8	179		897

[a] Public exposures: typical at 100 and 500 feet, extreme at 25 and 100 feet.
[b] Worker exposures: typical is based on average dose; extreme is based on upper 95 percent confidence level.

Note: MOSs greater than 10,000 are listed as 10,000. MOSs are based on systemic NOELs of 0.23 and 5.0 and a reproductive NOEL of 25.

For methyl parathion, there are moderate to significant risks of systemic effects and slight to moderate risks of reproductive effects from being directly sprayed by the insecticide, from drinking reservoir water contaminated by a release, and from eating berries or legumes that were directly sprayed.

Risks to Workers—Typical Exposures. Based on effect levels determined in human studies, malathion poses a moderate risk to observer/monitoring team and to hiboy and mist blower operators. Methyl parathion poses a slight risk to mixer/loaders and a moderate to significant risk to hiboy and mist blower operators. Based on the rat NOEL, MOSs for methyl parathion indicate a slight to moderate risk to pilots, a moderate to significant risk to mixer/loaders, and a significant

Table A-22. Control Program Margins of Safety for DIFLUBENZURON

Exposure scenario	Systemic		Reproductive[c]	
	Typical	Extreme	Typical	Extreme
Public[a]:				
Dermal and inhalation:				
Drift	10,000	3,029	10,000	10,000
Dietary:				
Water	10,000	2,667	10,000	10,000
Fish	10,000	61	10,000	488
Venison	9,615	5,494	10,000	10,000
Legumes	10,000	613	10,000	10,000
Berries	10,000	1,225	10,000	10,000
Workers[b]:				
Pilot	1,782	823	10,000	6,583
Aerial mixer/loader	804	272	6,583	2,179
Observer/environmental monitoring team	2,463	6	1,146	125
Hiboy operator	6	-1	46	6
Mist blower operator	9	4	71	33
Accidents:				
Spill of concentrate		-66		-8
Broken hose		-17		-2
Immediate field reentry		2,340		10,000
Direct spray—adult		265		2,122
Drinking reservoir water/release		222		1,779
Eating berries—direct spray		700		5,600
Eating legumes—direct spray		350		2,800

[a] Public exposures: typical at 100 and 500 feet, extreme at 25 and 100 feet.
[b] Worker exposures: typical is based on average dose; extreme is based on upper 95 percent confidence level.
[c] For reproductive MOSs from diflubenzuron, a MOS less than 100 may not necessarily indicate a risk of adverse effects, because the NOEL used in this analysis was the highest dose tested in any diflubenzuron reproductive study.

Note: MOSs greater than 10,000 are listed as 10,000. MOSs are based on a systemic NOEL of 1 and a reproductive NOEL >8.

risk to observer/monitoring team workers and hiboy and mist blower operators. Based on a rat study, diflubenzuron also presents a moderate to significant risk of systemic effects and a slight risk of reproductive effects to hiboy and mist blower operators.

Risks to Workers—Extreme Exposures. Based on effect levels determined in human studies, extreme exposures to both malathion and methyl parathion present a significant risk of systemic effects to observer/environmental monitoring team workers and hiboy and mist blower operators. The MOS for malathion, based on human studies, indicates a slight to moderate risk of reproductive effects to observer/monitoring

Table A-23. Control Program Margins of Safety for METHYL PARATHION

Exposure scenario	Systemic				Reproductive (Rat)	
	Typical		Extreme		Typical	Extreme
	Human	Rat	Human	Rat		
Public[a]:						
Dermal and inhalation:						
Drift	10,000	10,000	244	20	10,000	197
Dietary:						
Water	10,000	889	206	17	8,890	167
Fish	10,000	10,000	-2	-20	10,000	-2
Venison	672	60	426	34	601	343
Legumes	2,540	204	47	4	2,042	38
Berries	5,065	408	948	8	4,083	77
Workers[b]:						
Pilot		11	36	5	111	51
Aerial mixer/loader		5	21	2	50	17
Observer/environmental monitoring team		-1	1	-10	9	-1
Hiboy operator		-7	-5	-55	1	-6
Mist blower operator		-5	1	-11	2	-1
Accidents:						
Spill of concentrate			-204	-2,533		-253
Broken hose			-102	-1,267		-127
Immediate field reentry			657	58		585
Direct spray—adult			17	2		17
Drinking reservoir water/release			39	3		31
Eating berries—direct spray			54	4		44
Eating legumes—direct spray			27	2		22

[a] Public exposures: typical at 100 feet, extreme at 25 feet.
[b] Worker exposures: typical is based on average dose; extreme is based on upper 95 percent confidence level.

Note: MOSs greater than 10,000 are listed as 10,000. MOSs are based on systemic NOELs of 0.025 and 0.31 and a reproductive NOEL of 0.25.

team workers and hiboy operators. MOSs for methyl parathion indicate a slight to moderate risk of both systemic and reproductive effects to pilots and mixer/loaders.

Based on effect levels found in rat studies, extreme exposures to malathion indicate moderate to significant risks of systemic effects and slight to moderate risks of reproductive effects to observer/monitoring team workers and hiboy operators. Mist blower operators are at slight to moderate and slight risk of systemic and reproductive effects, respectively, from malathion. MOSs for methyl parathion indicate significant risks of systemic effects and slight to moderate risks of reproductive effects to pilots and mixer/loaders. MOSs for the observer/monitoring team and hiboy and mist blower operators indicate a significant risk of systemic and reproductive effects from methyl parathion. Extreme

exposures to diflubenzuron pose a moderate to significant risk to observer/monitoring team workers and hiboy and mist blower operators. Hiboy operators are at significant risk from diflubenzuron. MOSs for diflubenzuron also indicate a moderate to significant and slight to moderate risk of reproductive effects to hiboy and mist blower operators, respectively.

Risks to Workers—Accidental Exposures. Accident scenarios for workers include dermal exposure from a spill of concentrate, dermal exposure from the spray from a broken hose while loading aircraft, and immediate reentry into a treated area.

Malathion, diflubenzuron, and methyl parathion present significant systemic and reproductive risks from a spill of concentrate on the skin or spray from a broken hose. Additionally, methyl parathion poses a slight risk of systemic effects from immediate reentry into a treated area.

Cancer Risks

Cancer risk estimates to workers and members of the public as a result of exposure to malathion or diflubenzuron are presented in table A-24; risks greater than 1 in 1 million are discussed in the following paragraphs.

Cancer risks to members of the public are less than 1 in 1 million for all exposures from malathion or diflubenzuron under typical, extreme, and accidental exposure scenarios. Therefore, negligible cancer risks to the public are expected to result from public exposure to these insecticides as a result of the boll weevil control program in Alabama.

There could be significant cancer risks from malathion for hiboy and mist blower operators of 2 in 10,000 and 1 in 10,000, respectively. As well, malathion poses a potential cancer risk to the observer/monitoring team, mixer/loader and pilot of 4.9 in 100,000, 1.1 in 100,000, and 4.6 in 1 million, respectively. The calculated cancer risk also exceeds 1 in 1 million for diflubenzuron exposure to hiboy operators (5.5 in 10,000), mist blower operators (2.4 in 10,000), observer/monitoring team (1.2 in 100,000), mixer/loader (2.8 in 1 million), and pilots (1.2 in 1 million). Accidental exposures to workers can also result in elevated cancer risk probabilities. Risks from malathion are 4.81 in 100,000 from spilled concentrate or spray from a broken hose. Estimated cancer probabilities as a result of diflubenzuron exposure are 6.03 in 100,000 from spilled concentrate on the skin and 2.41 in 10,000 from being sprayed from a broken hose. For both insecticides, cancer risks are less than 1 in 1 million for immediate reentry to a treated area.

Table A-24. Control Program Lifetime Cancer Risks

Exposure scenario	Risk	
	Malathion[a]	Diflubenzuron[b]
Public:		
Dermal and inhalation:		
Drift	0.00000000228	0.0000000118
Dietary:		
Water	0.00000000323	0.00000000164
Fish	0.000000299	0.0000000409
Venison	0.00000000826	0.00000000398
Legumes	0.000000107	0.0000000525
Berries	0.0000000537	0.0000000263
Workers:		
Pilot	0.00000456	0.00000118
Aerial mixer/loader	0.0000108	0.00000279
Observer/environmental monitoring team	0.0000490	0.0000127
Hiboy operator	0.000217	0.000550
Mist blower operator	0.000123	0.000237
Accidents:		
Spill of concentrate	0.0000481	0.0000603
Broken hose	0.0000481	0.000241
Immediate field reentry	0.0000000000516	0.000000000287
Direct spray—adult	0.00000000420	0.00000000250
Drinking reservoir water/release	0.0000000110	0.00000000281
Eating berries—direct spray	0.00000000197	0.000000000961
Eating legumes—direct spray	0.00000000394	0.00000000192

[a] Cancer risks are based on a cancer potency value of 0.00376 $(mg/kg/day)^{-1}$ (CDHS, 1980).
[b] Cancer risks are based on a cancer potency value of 0.01718 $(mg/kg/day)^{-1}$. The carcinogenicity information on diflubenzuron is inconclusive; however, because positive results were obtained in one study, a cancer risk analysis was conducted (EPA, 1979).

Note: Risk calculations assume typical exposure 90 percent of the time and extreme exposure 10 percent of the time.

Wildlife and Aquatic Species Risk Assessment

This section contains the quantitative risk assessment to determine the potential effects of insecticide use on the wildlife and aquatic species in central and northern Alabama, should the program expand into these areas of the State. The wildlife risk assessment includes risks to mammals, birds, amphibians, reptiles, and nontarget terrestrial invertebrates. The aquatic species risk assessment includes risks to fish and aquatic invertebrates.

The wildlife and aquatic species risk assessment consists of three analytic elements: a hazard analysis, an exposure analysis, and a risk analysis. A hazard analysis requires the gathering of information to determine the toxic properties of each insecticide. Species hazard levels are derived from field studies and from the results of laboratory studies

of animals, such as rats, mice, rabbits, and fish. An exposure analysis involves the calculation of insecticide exposures to nontarget species and the estimation of the doses likely to result from those exposures. A risk analysis requires the comparison of the hazard information with the dose estimates to predict the toxic effects to wildlife and aquatic species during the given conditions of exposure.

Wildlife and Aquatic Species Hazard Analysis

This section presents a review of toxicological information on the hazards to wildlife and aquatic species from the three insecticides—malathion, diflubenzuron, and methyl parathion—considered for use in Alabama. For each insecticide, its toxicity to mammals, birds, insects, fish, aquatic invertebrates, reptiles, and amphibians is presented as a result of laboratory and field studies.

Appendix B contains a complete description of the hazard analyses for malathion, diflubenzuron, and methyl parathion.

Wildlife and Aquatic Species Exposure Analysis

This section presents the methodologies used to estimate exposures to wildlife and aquatic species from the three insecticides proposed for use in Alabama. To assess the control program's potential risk to nontarget species, exposures were calculated for a group of wildlife and aquatic species representative of those that typically inhabit the State of Alabama. These species represent a range of animal classes, body sizes, and diets for which biological parameters are generally available.

Appendix B contains a complete description of the methodologies used for the exposure analysis. The results of these exposure scenarios are presented in table A-25. For the aquatic species risk assessment, the two highest concentrations from the drift, average runoff, and maximum runoff scenarios were assumed to represent the typical and extreme farm pond estimated environmental concentrations (EECs). However, because the two runoff scenarios produced higher concentrations than the drift scenario for all three insecticides, the average runoff scenario was used to represent the typical case and the maximum runoff scenario was used to represent the extreme case. The pond surface spray scenario was not included in the risk assessment because this scenario represents a worst case, accidental situation that should be prevented by proper operational procedures.

Wildlife and Aquatic Species Risk Analysis

This section considers the potential effects of malathion, diflubenzuron, and methyl parathion on nontarget species for the proposed expansion of the boll weevil control program into central and northern Alabama. The risks of insecticide use to wildlife and aquatic species are directly related to the inherent toxicity of each insecticide and the amount of insecticide (dose) individual organisms ingest during boll weevil control program operations. The wildlife and aquatic species risk analysis compares estimated acute exposures of representative species with the acute toxicity levels determined in laboratory studies.

Table A-25. Farm Pond EECs for Four Exposure Scenarios

Insecticide	EECs (mg/L)			
	Drift	Average runoff	Maximum runoff	Direct spray
Malathion	0.0115	0.0455	0.168	0.0870
Diflubenzuron	0.00123	0.00261	0.00483	0.00929
Methyl parathion	0.00492	0.00946	0.0306	0.0372

Wildlife Risk Analysis

Estimation of Wildlife Risks. The criterion EPA (1986) uses in its ecological risk assessment of nontarget species was used to determine the risks to the different representative wildlife species and the relative risks among the three insecticides. The EPA criterion calls for a comparison of the dose received by an animal with the laboratory-determined LD_{50} for the most closely related laboratory test species.

For nonendangered terrestrial wildlife species, EPA (1986) assessed the risk of pesticide exposure according to the following scale:

Low—Expected Dose $<1/5$ LD_{50}

Moderate—$1/5$ $LD_{50} \leq$ Expected Dose $<LD_{50}$

High—Expected Dose $\geq LD_{50}$

Doses below the $1/5$ LD_{50} level (low) are assumed to present a low or negligible risk, doses between the $1/5$ LD_{50} level and the LD_{50} (moderate) are assumed to present a risk that may be mitigated by the restricted use of pesticide, and doses above the LD_{50} (high) are assumed to present an unacceptable risk.

Risks to Wildlife. The potential risks to representative wildlife species in Alabama are presented in tables A-26 through A-28. Each table presents the total typical and extreme dose estimates for the representative nontarget species. The LD_{50}s for the indicator species and the subsequent $1/5$ LD_{50} values are also provided. Any doses that exceed the $1/5$ LD_{50} criterion are noted.

Malathion—According to the results of the wildlife risk assessment, the honey bee is the only representative wildlife species likely to be affected by the use of malathion. Because the extreme dose estimate greatly exceeds the LD_{50}, any honey bees in or adjacent to a cotton field during spraying operations are likely to be killed.

Diflubenzuron—The wildlife risk assessment indicates that none of the representative wildlife species in Alabama will be adversely affected by

Table A-26. Risks to Representative Wildlife Species From MALATHION

Representative species	Typical dose estimate (mg/kg)	Extreme dose estimate (mg/kg)	1/5 LD_{50} (mg/kg)	LD_{50} (mg/kg)	Indicator species
Birds:					
Eastern kingbird (*Tyrannus tyrannus*)	1.08	47.5	80.0	400	Bobwhite
Northern bobwhite (*Colinus virginianus*)	0.382	17.3	80.0	400	Bobwhite
American kestrel (*Falco sparverius*)	0.619	38.6	80.0	400	Bobwhite
Belted kingfisher (*Megacercyle alcyon*)	0.365	14.5	297.0	1,485	Mallard
Mammals:					
Eastern cottontail (*Sylvilagus floridanus*)	0.128	14.5	50.0	250	Rabbit
Cotton mouse (*Peromyscus gossypinus*)	1.59	70.2	101.0	507	Mouse
White-tailed deer (*Odocoileus virginianus*)	0.017	2.68	10.6	53	Cattle
Red fox (*Vulpes fulva*)	0.073	6.17	275.0	1,375	Rat
Reptiles:					
Eastern hognose snake (*Heterodon platyrhinos*)	0.526	43.4	80.0	400	Bobwhite
Amphibians:					
Fowler's toad (*Bufo woodhousei fowleri*)	0.677	29.5	80.0	400	Bobwhite
Insect:					
Honey bee (*Apis mellifera*)	0.311	40.3[a]	1.182	5.908	Honey bee
Domestic animals:					
Cow	0.00783	3.28	10.6	53.0	Cow
Chicken	0.0876	4.13	30.0	150.0	Chicken
Dog	0.0365	1.50	275.0	1,375	Rat

[a] Estimated dose EPA (1986) risk criterion of 1/5 LD_{50}.

Table A-27. Risks to Representative Wildlife Species From DIFLUBENZURON

Representative species	Typical dose estimate (mg/kg)	Extreme dose estimate (mg/kg)	1/5 LD_{50} (mg/kg)	LD_{50} (mg/kg)	Indicator species
Birds:					
Eastern kingbird (*Tyrannus tyrannus*)	0.112	5.00	400	2,000	Mallard
Northern bobwhite (*Colinus virginianus*)	0.0402	1.88	400	2,000	Mallard
American kestrel (*Falco sparverius*)	0.0645	4.08	400	2,000	Mallard
Belted kingfisher (*Megacercyle alcyon*)	0.0493	1.80	400	2,000	Mallard
Mammals:					
Eastern cottontail (*Sylvilagus floridanus*)	0.0139	1.51	928	4,640	Rat
Cotton mouse (*Peromyscus gossypinus*)	0.166	7.51	928	4,640	Mouse
White-tailed deer (*Odocoileus virginianus*)	0.00194	0.283	928	4,640	Rat
Red fox (*Vulpes fulva*)	0.00801	0.713	928	4,640	Rat
Reptiles:					
Eastern hognose snake (*Heterodon platyrhinos*)	0.0566	4.65	400	2,000	Mallard
Amphibians:					
Fowler's toad (*Bufo woodhousei fowleri*)	0.0839	3.65	400	2,000	Mallard
Insect:					
Honey bee (*Apis mellifera*)	0.032	4.13	191	957	Honey bee
Domestic animals:					
Cow	0.000902	0.340	928	4,640	Rat
Chicken	0.0102	0.873	400	2,000	Mallard
Dog	0.00408	0.168	928	4,640	Rat

Table A-28. Risks to Representative Wildlife Species From METHYL PARATHION

Representative species	Typical dose estimate (mg/kg)	Extreme dose estimate (mg/kg)	1/5 LD_{50} (mg/kg)	LD_{50} (mg/kg)	Indicator species
Birds:					
Eastern kingbird (*Tyrannus tyrannus*)	0.446	19.7[a]	2.0	10.0	Red-winged blackbird
Northern bobwhite (*Colinus virginianus*)	0.160	7.30[a]	1.51	7.56	Bobwhite
American kestrel (*Falco sparverius*)	0.259	16.1[a]	0.616	3.08	American kestrel
Belted kingfisher (*Megacercyle alcyon*)	0.188	6.98[a]	1.32	6.60	Mallard
Mammals:					
Eastern cottontail (*Sylvilagus floridanus*)	0.0554	6.05	84.0	430.0	Rabbit
Cotton mouse (*Peromyscus gossypinus*)	0.658	29.2[a]	4.6	23.0	Mouse
White-tailed deer (*Odocoileus virginianus*)	0.00775	1.13[a]	0.72	3.6	Rat
Red fox (*Vulpes fulva*)	0.0318	2.66	18.0	90.0	Dog
Reptiles:					
Eastern hognose snake (*Heterodon platyrhinos*)	0.226	18.4[a]	1.51	7.56	Bobwhite
Amphibians:					
Fowler's toad (*Bufo woodhousei fowleri*)	0.335	14.6[a]	1.51	7.56	Bobwhite
Insect:					
Honey bee (*Apis mellifera*)	0.128[a]	16.5[a]	0.102	0.508	Honey bee
Domestic animals:					
Cow	0.00361	1.36[a]	0.72	3.6	Rat
Chicken	0.0381	2.05[a]	1.51	7.56	Bobwhite
Dog	0.0163	0.672	18.00	90.00	Dog

the use of diflubenzuron because none of the typical or extreme dose estimates exceed the 1/5 LD_{50} value.

Methyl parathion—The use of methyl parathion in the proposed expansion of the control program may present only a moderate risk to honey bees that receive a typical dose of the insecticide. However, an extreme dose of methyl parathion may present a significant risk to the honey bee. Extreme doses may also present moderate risks to the northern bobwhite, white-tailed deer, cow, and chicken, and significant risks to the eastern kingbird, American kestrel, belted kingfisher, cotton mouse, eastern hognose snake, and Fowler's toad.

Aquatic Species Risk Analysis

Estimation of Aquatic Species Risks. EPA's (1986) ecological risk assessment analyzes potential risks to aquatic species by comparing the dose received by an animal with the laboratory-determined LC_{50} for the most closely related laboratory test species. Thus, the following risk categories were used to assess the control program's effect on nontarget aquatic species in Alabama:

Low—EEC $<1/10\ LC_{50}$

Moderate—$1/10\ LC_{50} \leq$ EEC $<1/2\ LC_{50}$

High—EEC $\geq 1/2\ LC_{50}$

Note that the risks to clams and aquatic reptiles were not quantified in volume 1 of the EIS because no information was available on the toxicity of the three control program insecticides to these organisms. In this site-specific assessment, however, a risk assessment was conducted for clams and aquatic reptiles by pairing each species with a toxicity surrogate, or the most closely related aquatic species for which laboratory toxicity data exist. The American oyster, a saltwater bivalve species, was used as a toxicity surrogate for the effects of malathion on freshwater mussel species in Alabama. To determine the effects of diflubenzuron and methyl parathion on freshwater clams, fish were used as toxicity surrogates because the evidence suggests that known fish toxicants are comparatively less toxic to freshwater mussels during acute exposure (Havlik and Marking, 1987).

For aquatic reptiles, juvenile amphibians and a fish species were used as toxicity surrogates because such organisms are likely to be more susceptible to insecticide exposure than reptiles. Aquatic reptiles generally possess highly impervious shells or skin, which reduces the possibility of dermal exposure, and have lungs that require periodic resurfacing for fresh oxygen. However, tadpoles and fish have more permeable skin and rely solely on filtered water for oxygen. Consequently, the use of such organisms as toxicity surrogates is a conservative assumption that probably overstates the risk of insecticide exposure to aquatic reptiles. The tadpole of the western chorus frog was used as

the toxicity surrogate for malathion and methyl parathion, and the channel catfish was used for diflubenzuron.

Risks to Aquatic Species. The potential risks to representative aquatic species in Alabama are presented in tables A-29 through A-31. Each table presents the total typical and extreme EECs for the water bodies containing the representative nontarget species. The LC_{50}s for the indicator species and the subsequent 1/10 LC_{50} values are also provided. Any doses that exceed the 1/10 LC_{50} criterion were noted.

Malathion—According to the results of the aquatic species risk assessment, the use of malathion in Alabama may present a significant risk to any bluegills or eastern painted turtles that live in farm ponds receiving either typical or extreme EECs of the insecticide. Also, largemouth bass and eastern painted turtles in farm ponds face a moderate risk from the typical EEC and a significant risk from the extreme EEC, while farm pond populations of Fowler's toad (tadpole) face a moderate risk from both the typical and extreme EECs.

The results also indicate that the walleye in the Cahaba River and the black crappie in the Alabama River face a moderate risk from the extreme EEC of malathion, while the scud and the stonefly (first year class) face significant risks from both the typical and extreme EECs in the Cahaba, Tennessee, and Alabama Rivers. The first instar of *Daphnia magna* faces moderate risks from typical and extreme EECs in the Tennessee River.

Diflubenzuron—The aquatic species risk assessment indicates that none of the representative aquatic species in Alabama will be adversely affected by the use of diflubenzuron because none of the typical or extreme EECs exceed the 1/10 LC_{50} value.

Methyl parathion—None of the fish, clams, aquatic reptiles, or amphibians in Alabama should be adversely affected by the use of methyl parathion. However, the risk assessment indicates that some species of aquatic invertebrates may be at risk during the boll weevil control program. For example, both the typical and extreme EECs in the Tennessee River present a moderate risk to the first instar of *Daphnia magna* and a moderate risk to the first instar of the daphnid *Simocephalus serrulatus.* Also, the extreme EEC of methyl parathion in the Cahaba River presents a significant risk to crayfish.

Thus, methyl parathion may cause short-term population declines in some aquatic invertebrate populations. These declines could, in turn, have some adverse effects on aquatic vertebrate species. Both effects should be relatively short-lived because any concentrations of methyl parathion will dissipate rapidly from degradation and dilution; and in general, these species have high reproductive capacities.

Table A-29. Risks to Representative Aquatic Species From MALATHION

Representative species	Representative habitat	Typical EEC (mg/L)	Extreme EEC (mg/L)	1/10 LC_{50} (mg/L)	LC_{50} or EC_{50} (mg/L)	Indicator species
Fish:						
Black crappie (*Pomoxis nigromaculatus*)	Alabama River	0.00167	0.00206[a]	0.0020	0.020	Bluegill
Bluegill (*Lepomis macrochirus*)	Farm pond	0.0455[a]	0.168[a]	0.0020	0.020	Bluegill
Channel catfish (*Ictalarus punctatus*)	Tennessee River	0.00036	0.0004	0.8970	8.970	Channel catfish
Largemouth bass (*Micropterus salmoides*)	Farm pond	0.0455[a]	0.168[a]	0.0285	0.285	Largemouth bass
Walleye (*Stizostedion vitreum*)	Cahaba River	0.00065	0.00994[a]	0.0020	0.020	Bluegill
Clams:						
Alabama spike mussel (*Elliptio raca*)	Alabama River	0.00167	0.00206	0.9070	9.070[b]	American oyster
Ebony shell mussel (*Fusconaia ebenea*)	Tennessee River	0.00036	0.0004	0.9070	9.070[b]	American oyster
Aquatic reptiles:						
Banded water snake (*Natrix sipedon fasciata*)	Alabama River	0.00167	0.00206	0.0200	0.200	Western chorus frog (tadpole)
Eastern painted turtle (*Chrysemys picta picta*)	Farm pond	0.0455[a]	0.168[a]	0.0200	0.200	Western chorus frog (tadpole)

Table A-29. Risks to Representative Aquatic Species From MALATHION (continued)

Representative species	Representative habitat	Typical EEC (mg/L)	Extreme EEC (mg/L)	1/10 LC_{50} (mg/L)	LC_{50} or EC_{50} (mg/L)	Indicator species
Invertebrates:						
Aquatic sowbug (*Asellus brevicaudus*)	Cahaba River	0.00065	0.00994	0.300	3.00	Aquatic sowbug
Daphnia magna, 1st instar	Tennessee River	0.00036[a]	0.0004[a]	0.0001	0.001	1st instar
Scud (*Gammarus fasciatus*)	Alabama River	0.00167[a]	0.00206[a]	0.000076	0.00076	Scud
Stonefly, first year class (*Pteronarcella badia*)	Cahaba River	0.00065[a]	0.00994[a]	0.00011	0.0011	Stonefly
Amphibians:						
Fowler's toad (tadpole) (*Bufo woodhousei fowleri*)	Farm pond	0.0455[a]	0.168[a]	0.0420	0.420	Fowler's toad (tadpole)

[a] Exceeds EPA (1986) risk criterion of 1/10 LC_{50} for nonendangered aquatic species.
[b] 48-hour median threshold limit (TLm).

Table A-30. **Risks to Representative Aquatic Species From DIFLUBENZURON**

Representative species	Representative habitat	Typical EEC (mg/L)	Extreme EEC (mg/L)	1/10 LC_{50} (mg/L)	LC_{50} or EC_{50} (mg/L)	Indicator species
Fish:						
Black crappie (*Pomoxis nigromaculatus*)	Alabama River	0.0000051	0.0000053	37.0	370.0	Channel catfish
Bluegill (*Lepomis macrochirus*)	Farm pond	0.00261	0.00483	66.0	660.0	Bluegill
Channel catfish (*Ictalarus punctatus*)	Tennessee River	0.000015	0.000016	37.0	370.0	Channel catfish
Largemouth bass (*Micropterus salmoides*)	Farm pond	0.00261	0.00483	37.0	370.0	Channel catfish
Walleye (*Stizostedion vitreum*)	Cahaba River	0.000038	0.0011	37.0	370.0	Channel catfish
Clams:						
Alabama spike mussel (*Elliptio raca*)	Alabama River	0.0000051	0.0000053	37.0	370.0	Channel catfish
Ebony shell mussel (*Fusconaia ebenea*)	Tennessee River	0.000015	0.000016	37.0	370.0	Channel catfish
Aquatic reptiles:						
Banded water snake (*Natrix sipedon fasciata*)	Alabama River	0.0000051	0.0000053	37.0	370.0	Channel catfish
Eastern painted turtle (*Chrysemys picta picta*)	Farm pond	0.00261	0.00483	37.0	370.0	Channel catfish
Invertebrates:						
Daphnia sp., 1st instar	Tennessee River	0.000015	0.000016	0.00015	0.0015	Mixed stages
Scud (*Gammarus fasciatus*)	Alabama River	0.0000051	0.0000053	0.0025	0.025	Scud
Stonefly, first year class (*Pteronarcella badia*)	Cahaba River	0.000038	0.0011	5.75	57.5	Stonefly

Table A-31. Risks to Representative Aquatic Species From METHYL PARATHION

Representative species	Representative habitat	Typical EEC (mg/L)	Extreme EEC (mg/L)	1/10 LC_{50} (mg/L)	LC_{50} or EC_{50} (mg/L)	Indicator species
Fish:						
Black crappie (*Pomoxis nigromaculatus*)	Alabama River	0.000263	0.000307	0.306	3.06	Yellow perch
Bluegill (*Lepomis macrochirus*)	Farm pond	0.00946	0.0306	0.438	4.38	Bluegill
Channel catfish (*Ictalarus punctatus*)	Tennessee River	0.000058	0.000066	0.524	5.24	Channel catfish
Largemouth bass (*Micropterus salmoides*)	Farm pond	0.00946	0.0306	0.522	5.22	Largemouth bass
Walleye (*Stizostedion vitreum*)	Cahaba River	0.00016	0.0042	0.306	3.06	Yellow perch
Clams:						
Alabama spike mussel (*Elliptio raca*)	Alabama River	0.000263	0.000307	0.306	3.06	Yellow perch
Ebony shell mussel (*Fusconaia ebenea*)	Tennessee River	0.000058	0.000066	0.306	3.06	Yellow perch
Aquatic reptiles:						
Banded water snake (*Natrix sipedon fasciata*)	Alabama River	0.000263	0.000307	0.370	3.70	Western chorus frog (tadpole)
Eastern painted turtle (*Chrysemys picta picta*)	Farm pond	0.00946	0.0306	0.370	3.70	Western chorus frog (tadpole)
Invertebrates:						
Crayfish (*Procambarus clarki*)	Cahaba River	0.00016	0.0042[a]	0.0003	0.003	Crayfish
Damselfly, late instar (*Ischnuva verticalis*)	Alabama River	0.000263	0.000307	0.0033	0.033	Damselfly
Daphnid, 1st instar (*Simocephalus serrulatus*)	Tennessee River	0.000058[a]	0.000066[a]	0.000037	0.00037	Daphnid
Daphnia magna, 1st instar	Tennessee River	0.000058[a]	0.000066[a]	0.000014	0.00014	1st instar

Table A-31. Risks to Representative Aquatic Species From METHYL PARATHION (continued)

Representative species	Representative habitat	Typical EEC (mg/L)	Extreme EEC (mg/L)	1/10 LC_{50} (mg/L)	LC_{50} or EC_{50} (mg/L)	Indicator species
Amphibians:						
Upland chorus frog (tadpole) (*Pseudacris triseriata triseriata*)	Farm pond	0.00946	0.0306	0.370	3.70	Western chorus frog (tadpole)

[a] Exceeds EPA (1986) risk criterion of 1/10 LC_{50} for nonendangered aquatic species.

Attachment B

Federally Listed Endangered, Threatened, and Proposed Species in Alabama

Introduction

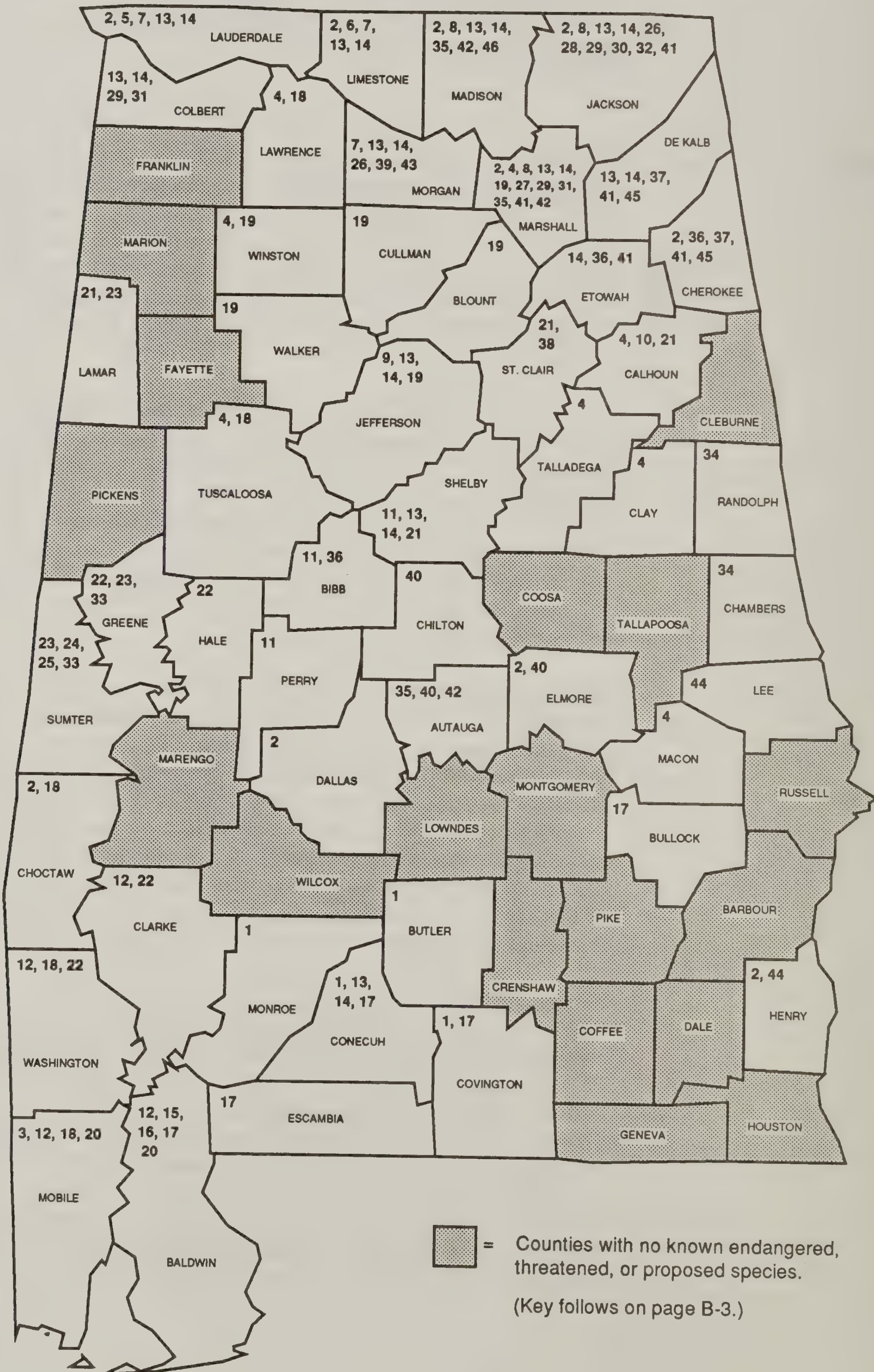
The U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) has proposed a National Boll Weevil Cooperative Control Program to be implemented in 17 Southern States across the U.S. Cotton Belt. This environmental impact statement (EIS) describes the potential impacts of the program on the human environment and the preferred alternative of the cooperative program—full Federal involvement in eradicating the boll weevil as an economic cotton pest in the United States.

In addition, APHIS prepared a biological assessment in accordance with the Endangered Species Act of 1973, as amended. The biological assessment, which is intended to initiate formal consultation between APHIS and the Fish and Wildlife Service, assesses the impact the proposed National Boll Weevil Cooperative Control Program may have on the 198 federally listed endangered, threatened, and proposed species in cotton-producing areas. The biological assessment was used to determine what protection measures would ensure that those species are not jeopardized by the program.

This attachment assesses the potential risk that implementation of the National Boll Weevil Cooperative Control Program in the State of Alabama may pose to each of the State's 46 federally listed endangered, threatened, and proposed species. The assessment is based on the nontarget species risk assessment conducted for the National Boll Weevil Cooperative Control Program and on specific life-history information gathered on each species. It consists of a risk assessment discussion and a species-specific assessment section with a description of the kinds of protection measures recommended for endangered, threatened, and proposed species in Alabama.

Figure B-1 indicates the geographical distribution of these endangered, threatened, and proposed species. Table B-1 summarizes the potential risk to individual species and shows that "no effect" is anticipated for 12 species because of their geographic distribution or because their habitat is not close to the agricultural lands to be treated in the control program. However, 34 species were determined to be "may affect" cases because the species may be adversely affected by the direct toxic or indirect effects of the program insecticides or may be otherwise disturbed by boll weevil control measures or insecticide application methods (for example, the noise of the spray planes). Table B-1 also lists each species' scientific name and its counties of occurrence.

Figure B-1. Location of Endangered, Threatened, and Proposed Species in the State of Alabama



Key to Figure B-1: Location of Endangered, Threatened, and Proposed Species in the State of Alabama

Amphibians

Red Hills salamander	1

Birds

Bald eagle	2
Piping plover	3
Red-cockaded woodpecker	4

Fish

Alabama cavefish	5
Boulder (Elk River) darter	6
Slackwater darter	7
Snail darter	8
Watercress darter	9
Pygmy sculpin	10
Cahaba shiner	11
Gulf sturgeon	12

Mammals

Gray bat	13
Indiana bat	14
Alabama beach mouse	15
Perdido Key beach mouse	16

Reptiles

Eastern indigo snake	17
Gopher tortoise	18
Flattened musk turtle	19
Alabama red-bellied turtle	20

Snail

Tulotoma snail	21

Clams

Inflated heelsplitter mussel	22
Judge Tait's mussel	23
Marshall's mussel	24
Penitent mussel	25
Alabama lamp pearly mussel	26
Orange-footed (=pimple back) pearly mussel	27
Pale lilliput pearly mussel	28
Pink mucket pearly mussel	29
Fine-rayed pigtoe	30
Rough pigtoe	31
Shiny pigtoe	32
Stirrup shell	33

Plants

Crustaceans

Table B-1. Summary of Potential Risks From the National Boll Weevil Cooperative Control Program to Endangered, Threatened, and Proposed Species in Alabama

Common name	Scientific name	County	Conclusion
Mammals:			
Bat, gray	*Myotis grisescens*	Colbert Conecuh De Kalb Jackson Jefferson Lauderdale Limestone Madison Marshall Morgan Shelby	May affect
Bat, Indiana	*Myotis sodalis*	Colbert Conecuh De Kalb Jackson Jefferson Lauderdale Limestone Madison Marshall Morgan Shelby	May affect
Mouse, Alabama beach	*Peromyscus polionotus ammobates*	Baldwin	No effect
Mouse, Perdido Key beach	*Peromyscus polionotus trissyllepis*	Baldwin	No effect

Table B-1. Summary of Potential Risks From the National Boll Weevil Cooperative Control Program to Endangered, Threatened, and Proposed Species in Alabama (continued)

Common name	Scientific name	County	Conclusion
Birds:			
Eagle, bald	*Haliaeetus leucocephalus*	Barbour Cherokee Choctaw Dallas Elmore Henry Jackson Lauderdale Limestone Madison Marshall	May affect
Plover, piping	*Charadrius melodus*	Mobile	May affect
Woodpecker, red-cockaded	*Picoides (=Dendrocopos) borealis*	Calhoun Clay Lawrence Macon Marshall Talladega Tuscaloosa Winston	May affect
Reptiles:			
Snake, eastern indigo	*Drymarchon corais couperi*	Baldwin Bullock Conecuh Covington Escambia	May affect
Tortoise, gopher	*Gopherus polyphemus*	Choctaw Mobile Washington	May affect

Table B-1. Summary of Potential Risks From the National Boll Weevil Cooperative Control Program to Endangered, Threatened, and Proposed Species in Alabama (continued)

Common name	Scientific name	County	Conclusion
Turtle, flattened musk	*Sternotherus depressus*	Blount Cullman Etowah Jefferson Lawrence Marshall Tuscaloosa Walker Winston	May affect
Turtle, Alabama red-bellied	*Pseudemys alabamensis*	Baldwin Mobile	May affect
Amphibians:			
Salamander, Red Hills	*Phaeognathus hubrichti*	Butler Conecuh Covington Monroe	No effect
Fish:			
Cavefish, Alabama	*Speoplatyrhinus poulsoni*	Lauderdale	May affect
Darter, boulder (=Elk River)	*Etheostoma wapiti*	Limestone	May affect
Darter, slackwater	*Etheostoma boschungi*	Lauderdale Limestone Madison Morgan	May affect
Darter, snail	*Percina tanasi*	Jackson Madison Marshall	May affect
Darter, watercress	*Etheostoma nuchale*	Jefferson	No effect
Sculpin, pygmy	*Cottus pygmaeus*	Calhoun	No effect

Table B-1. Summary of Potential Risks From the National Boll Weevil Cooperative Control Program to Endangered, Threatened, and Proposed Species in Alabama (continued)

Common name	Scientific name	County	Conclusion
Shiner, Cahaba	*Notropis cahabae*	Bibb Perry Shelby	May affect
Sturgeon, Gulf	*Acipenser oxyrhynchus desotoi*	Baldwin Clarke Mobile Washington	May affect
Snail:			
Snail, tulotoma	*Tulotoma magnifica*	Calhoun Coosa Elmore Shelby St. Clair	May affect
Clams:			
Mussel, inflated heelsplitter	*Potamilus inflatus*	Clarke Green Hale Washington	May affect
Mussel, Judge Tait's	*Pleurobema taitianum*	Greene Lamar Sumter	May affect
Mussel, Marshall's	*Pleurobema marshalli*	Sumter	May affect
Mussel, penitent	*Epioblasma (=Dysnomia) penita*	Lamar Sumter	May affect
Pearly mussel, Alabama lamp	*Lampsilis virescens*	Jackson	May affect
Pearly mussel, (=pimple back) orange-footed	*Plethobasus cooperianus*	Marshall	May affect
Pearly mussel, pale lilliput	*Toxolasma (=Carunculina) cylindrellus*	Jackson	May affect

Table B-1. Summary of Potential Risks From the National Boll Weevil Cooperative Control Program to Endangered, Threatened, and Proposed Species in Alabama (continued)

Common name	Scientific name	County	Conclusion
Pearly mussel, pink mucket	*Lampsilis orbiculata*	Colbert Jackson Marshall Morgan Lauderdale	May affect
Pigtoe, fine-rayed	*Fusconaia cuneolus*	Jackson	May affect
Pigtoe, rough	*Pleurobema plenum*	Colbert Marshall	May affect
Pigtoe, shiny	*Fusconaia edgariana*	Jackson	May affect
Stirrup shell	*Quadrula stapes*	Greene Sumter	May affect
Crustaceans:			
Shrimp, Alabama cave	*Palaemonias alabamae*	Madison	May affect
Plants:			
Amphianthus, little	*Amphianthus pusillus*	Chambers Randolph	No effect
Bladder-pod, lyrate	*Lesquerella lyrata*	Franklin Colbert	No effect
Buttons, Mohr's Barbara's	*Marshallia mohrii*	Bibb Cherokee Etowah	May affect
Harperella	*Ptilimnium nodosum* (=*P. fluviatile*)	Cherokee De Kalb	May affect
Leather flower, Alabama	*Clematis socialis*	Cherokee St. Clair	May affect
Fern, American hart's-tongue	*Phyllitis scolopendrium* var. *americana* (=*P. japonica* ssp. *a.*)	Morgan	No effect

Table B-1. Summary of Potential Risks From the National Boll Weevil Cooperative Control Program to Endangered, Threatened, and Proposed Species in Alabama (continued)

Common name	Scientific name	County	Conclusion
Pitcher-plant, Alabama canebrake	*Sarracenia rubra* ssp. *alabamensis* (=*S. alabamensis* ssp. *a.*)	Autauga Chilton Elmore	No effect
Pitcher-plant, green	*Sarracenia oreophila*	Cherokee De Kalb Etowah Jackson Marshall	No effect
Potato-bean, Price's	*Apios priceana*	Autauga Madison Marshall	No effect
Prairie-clover, leafy	*Dalea foliosa*	Morgan	No effect
Trillium, relict	*Trillium reliquum*	Henry Lee	May affect
Water-plantain, Kral's	*Sagittaria secundifolia*	Chatooga Cherokee De Kalb	May affect

Risk Assessment for Federally Listed Endangered, Threatened, and Proposed Species

This section describes the methodologies used to analyze the potential risks to the 46 nontarget organisms; which include mammals, birds, reptiles, an amphibian, fish, clams, a crustacean, insects, arachnids, and plants listed by the Fish and Wildlife Service as endangered, threatened, or proposed species and that may be affected by the use of the three chemical insecticides proposed for use in the National Boll Weevil Cooperative Control Program in Alabama. The results of the risk assessment are also presented in this attachment.

To assess the control program's potential risk to these species, a decision-tree analysis was performed for each species. The decision-tree consisted of a series of five questions posed for each of the 46 endangered, threatened, and proposed species. Specifically, the decision-tree questions were used to ascertain the following: (1) the occurrence of the species in cotton-producing counties, (2) the proximity of habitat areas to cotton fields or localities affected by cotton production, (3) direct toxicity to the species from insecticide exposure, (4) indirect effects to the species from insecticide application, and (5) the effects of application-method disturbances on the species. If the answers to questions 1 or 2 were "no" for a given species, the analysis stopped at that decision point and an assessment of "no effect" was concluded for that species. If the answers to both questions 1 and 2 were "yes," a complete decision-tree analysis was performed for the species and the severity of the impact from insecticide exposure was determined.

Question 3 of the decision-tree analysis, or the risk of direct toxicity from insecticide exposure, is the key component of the endangered, threatened, and proposed species risk assessment. To answer this question, a quantitative risk assessment was performed. The quantitative risk assessment consisted of three analytic elements: a hazard analysis, an exposure analysis, and a risk analysis.

The hazard analysis required gathering information to determine the toxic properties of each of the program insecticides. For each insecticide, results of laboratory and field studies are presented on the insecticide's toxicity to mammals, birds, insects, plants, fish, aquatic invertebrates, aquatic plants, reptiles, and amphibians.

The exposure analysis involved estimating potential exposures of nontarget species to the program insecticides and determining what doses were likely to result from those estimated exposures. Exposures were calculated for a group of terrestrial wildlife and aquatic species representative of those that typically inhabit various regions of the Cotton Belt. These species represent a range of animal classes, body sizes, and diets for which information on these biological parameters is generally available. The exposures derived for the representative wildlife species were then assumed to apply to the endangered, threatened, and proposed species evaluated in this assessment. For terrestrial species, typical and extreme exposures were estimated for each representative species using conservative assumptions for routine application operations. In both the typical and extreme dose calculations, the three

principal routes of exposure were examined: dermal, ingestion, and inhalation. For each aquatic habitat, the total concentration of each insecticide in water, or the estimated environmental concentration (EEC), was calculated by adding estimated runoff concentrations to drift concentrations. Two quantitative models, the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) and the Exposure Analysis Modeling System II (EXAMS II), were used to estimate runoff concentrations, and a third model, AGricultural DISPersion (AGDISP), was used to estimate drift concentrations from aerial insecticide applications. The analysis assumed that the aquatic organisms were exposed to insecticide residues by immersion in water bodies that had received varying levels of insecticide through runoff, drift, or direct spraying.

The risk analysis involved comparing the insecticide hazard information with the dose estimates to predict the toxic effects to wildlife and plants under the specified exposure conditions. Risks to wildlife and aquatic species from boll weevil control with insecticides are directly related to the inherent toxicity (hazard) of each insecticide to different organisms and to the amount of each chemical (dose) those organisms may take in as a result of boll weevil control operations. The wildlife and aquatic species risk analysis compares estimated acute exposures of representative species with the acute toxicity levels found in laboratory studies. For wildlife risks, the criterion the Environmental Protection Agency (EPA) uses in its ecological risk assessment (EPA, 1986) of endangered species was used to determine the risks to the different representative species and the relative risks among the three insecticides. The EPA criterion calls for a comparison of the dose received by an animal with the laboratory-determined median lethal dose (LD_{50}), which is the dose, usually administered orally, that kills 50 percent of the test animals for the most closely related laboratory test species. For endangered terrestrial wildlife species, EPA (1986) considers the risk to be unacceptable if the dose exceeds one-tenth of the LD_{50}. Doses below this level are assumed to present a low or negligible risk.

To estimate the susceptibility of the endangered, threatened, and proposed aquatic species to the program insecticides, each species was paired with a common aquatic species for which acute toxicity reference values have been determined. These references values are either the median lethal concentration (LC_{50}), which is the concentration of a toxicant in the water that kills 50 percent of the text organisms within a specified time, or the concentration of a toxicant that produces a specific effect on 50 percent of the test organisms (EC_{50}), which is often used with animals where determining death is difficult, such as with *Daphnia* sp. The aquatic species most sensitive to the three insecticides were selected in each case. The toxicity reference values were then compared with the EECs of each insecticide. According to EPA (1986), the risk to endangered aquatic species is unacceptable if the EEC equals or exceeds one-twentieth of the LC_{50}.

For more detailed descriptions of the hazard, exposure, and risk analyses, and the models used to calculate aquatic exposures, refer to chapter 4, appendix B, and appendix H.

The potential risks to the federally listed endangered, threatened, and proposed wildlife species are presented in table B-2. The table presents the total typical and extreme dose estimates for endangered, threatened, and proposed species, as determined for the representative wildlife species. The LD_{50}s for the indicator species and the subsequent one-tenth of the LD_{50} values are also provided. Any doses that exceed the one-tenth LD_{50} criterion are noted. The risk to each individual species and the protection measures suggested to safeguard the species from such risk, if necessary, are discussed in the species-specific assessments that follow.

The risks to endangered, threatened, and proposed aquatic species are presented in tables B-3 and B-4. Table B-3 lists the total typical and extreme EECs calculated for fish and clams, as well as each species' actual or representative habitat area. These tables also list the LC_{50}s and the subsequent one-twentieth LC_{50} values for each program insecticide. All EECs that exceed the one-twentieth of the LC_{50} criterion are noted. In similar fashion, table B-4 presents the approximation of risk to aquatic reptiles. Note that the aquatic exposure methodologies used in this supplement were unable to calculate EECs for one fish species, the Alabama cavefish, and one crustacean species, the Alabama cave shrimp. For these species, qualitative analyses of probable risk were performed using the results of the risk assessment for the other endangered, threatened, or proposed aquatic species in this attachment.

The risk to each individual species and the protection measures suggested to safeguard the species from such risk, if necessary, are discussed in the species-specific assessments in this attachment.

Species-Specific Assessment of Endangered, Threatened, and Proposed Species

This section describes the management strategies and protection measures designed to prevent possible adverse impacts to Alabama's endangered, threatened, and proposed species. The implementation of these strategies and measures will require close field-level cooperation between APHIS and the Fish and Wildlife Service to identify current locations of species and to tailor the control program operations to protect these species.

The location of many species is often a dynamic factor dependent on climate, species migration, and natural occurrences, such as fire, floods, and severe weather. The location of individual cotton fields also is a dynamic factor dependent on weather and market economics. The dynamics of both species locations and cotton production must be closely monitored to avoid species impact.

The following assessment groups each taxa's potentially affected species into "no effect" and "may affect" groups. In the discussion on each species, the "Analysis of Program Impacts" section contains a summary

Table B-2. Risk to Endangered, Threatened, and Proposed Wildlife Species in Alabama

Endangered, threatened, or proposed species	Nontarget representative species	Typical dose estimate (mg/kg/day)	Extreme dose estimate (mg/kg/day)	1/10 LD_{50} (mg/kg)	LD_{50} (mg/kg)	Indicator species
Malathion:						
Bat, gray (*Myotis grisescens*)	Deer mouse	1.59	70.2[a]	50.7	507	Mouse
Bat, Indiana (*Myotis sodalis*)	Deer mouse	1.59	70.2[a]	50.7	507	Mouse
Eagle, bald (*Haliaeetus leucocephalus*)	American kestrel	0.619	38.6	40	400	Bobwhite
Plover, piping (*Charadrius melodus*)	Belted kingfisher	0.365	14.5	148.5	1,485	Mallard
Woodpecker, red-cockaded (*Picoides* (=*Dendrocopos*) *borealis*)	Eastern kingbird	1.08	47.5[a]	40	400	Bobwhite
Snake, eastern indigo (*Drymarchon corais couperi*)	Western diamondback rattlesnake	0.526	43.4[a]	40	400	Bobwhite
Tortoise, gopher (*Gopherus polyphemus*)	Gopher tortoise	0.0177	4.55	40	400	Bobwhite
Diflubenzuron:						
Bat, gray (*Myotis grisescens*)	Deer mouse	0.166	7.51	464	4,640	Mouse
Bat, Indiana (*Myotis sodalis*)	Deer mouse	0.166	7.51	464	4,640	Mouse

Table B-2. Risk to Endangered, Threatened, and Proposed Wildlife Species in Alabama (continued)

Endangered, threatened, or proposed species	Nontarget representative species	Typical dose estimate (mg/kg/day)	Extreme dose estimate (mg/kg/day)	1/10 LD_{50} (mg/kg)	LD_{50} (mg/kg)	Indicator species
Eagle, bald (*Haliaeetus leucocephalus*)	American kestrel	0.0645	4.08	200	2,000	Mallard
Plover, piping (*Charadrius melodus*)	Belted kingfisher	0.0493	1.80	200	2,000	Mallard
Woodpecker, red-cockaded (*Picoides (=Dendrocopos) borealis*)	Eastern kingbird	0.112	5.00	200	2,000	Mallard
Snake, eastern indigo (*Drymarchon corais couperi*)	Western diamondback rattlesnake	0.0566	4.65	200	2,000	Mallard
Tortoise, gopher (*Gopherus polyphemus*)	Gopher tortoise	0.00219	0.482	200	2,000	Mallard
Methyl parathion:						
Bat, gray (*Myotis grisescens*)	Deer mouse	0.658	29.2[a]	2.3	23	Mouse
Bat, Indiana (*Myotis sodalis*)	Deer mouse	0.658	29.2[a]	2.3	23	Mouse
Eagle, bald (*Haliaeetus leucocephalus*)	American kestrel	0.258	16.1[a]	0.30 8	3.08	American kestrel
Plover, piping (*Charadrius melodus*)	Belted kingfisher	0.188	6.98[a]	0.66 0	6.60	Mallard
Woodpecker, red-cockaded (*Picoides (=Dendrocopos) borealis*)	Eastern kingbird	0.446	19.7[a]	1	10	Red-winged blackird

Table B-2. Risk to Endangered, Threatened, and Proposed Wildlife Species in Alabama (continued)

Endangered, threatened, or proposed species	Nontarget representative species	Typical dose estimate (mg/kg/day)	Extreme dose estimate (mg/kg/day)	1/10 LD_{50} (mg/kg)	LD_{50} (mg/kg)	Indicator species
Snake, eastern indigo (*Drymarchon corais couperi*)	Western diamondback rattlesnake	0.226	18.4[a]	0.756	7.56	Bobwhite
Tortoise, gopher (*Gopherus polyphemus*)	Gopher tortoise	0.00874	1.93[a]	0.756	7.56	Bobwhite

[a] Exceeds EPA (1986) risk criterion of 1/10 LD_{50} for endangered species.

Table B-3. Approximation of Acute Risk to Endangered, Threatened, and Proposed Fish and Mollusk Species in Streams, Headwaters, or Rivers That Receive Contaminated Runoff and Drift From Program Chemicals in Alabama

Endangered, threatened, or proposed species	Common species	LC_{50} (mg/L)	1/20 LC_{50} (mg/L)	Representative habitat	EEC (mg/L)	
					Typical	Extreme
Malathion:						
Cavefish, Alabama	Bluegill	0.02	0.001	Key Cave[a]	—[b]	—[b]
Darter, boulder	Bluegill	0.02	0.001	Elk River[a]	0.0014	0.0074[c]
Darter, slackwater	Bluegill	0.02	0.001	Swan Creek, Flint and Buffalo Rivers[a]	0.0309[c]	0.0333[c]
Darter, snail	Bluegill	0.02	0.001	Paint Rock River[a]	0.000884	0.0154[c]
Shiner, Cahaba	Bluegill	0.02	0.001	Cahaba River[a]	0.000645	0.000994
Sturgeon, Gulf	Bluegill	0.02	0.001	Alabama River	0.00168[c]	0.00206[c]
Snail, tulotoma	Bluegill	0.02	0.001	Kelly Creek[a]	0.000711	0.0183[c]
Mussel, inflated heelsplitter	American oyster	9.07	0.4535	Alabama River	0.00167	0.00206
Mussel, Judge Tait's	American oyster	9.07	0.4535	Sipsey River[a]	0.000394	0.0134
Mussel, Marshall's	American oyster	9.07	0.4535	Tennessee River[a]	0.00036	0.0004
Mussel, penitent	American oyster	9.07	0.4535	Alabama River	0.00167	0.00206
Pearly mussel, Alabama lamp	American oyster	9.07	0.4535	Paint Rock River[a]	0.000884	0.00154
Pearly mussel, orange-footed	American oyster	9.07	0.4535	Tennessee River[a]	0.00036	0.0004
Pearly mussel, pale lilliput	American oyster	9.07	0.4535	Paint Rock River[a]	0.000884	0.0154
Pearly mussel, pink mucket	American oyster	9.07	0.4535	Tennessee River[a]	0.00036	0.0004

Table B-3. Approximation of Acute Risk to Endangered, Threatened, and Proposed Fish and Mollusk Species in Streams, Headwaters, or Rivers That Receive Contaminated Runoff and Drift From Program Chemicals in Alabama (continued)

Endangered, threatened, or proposed species	Common species	LC_{50} (mg/L)	1/20 LC_{50} (mg/L)	Representative habitat	EEC (mg/L)	
					Typical	Extreme
Pigtoe, fine-rayed	American oyster	9.07	0.4535	Elk and Paint Rock Rivers[a]	0.00139	0.00741
Pigtoe, rough	American oyster	9.07	0.4535	Tennessee River[a]	0.00036	0.0004
Pigtoe, shiny	American oyster	9.07	0.4535	Paint Rock River[a]	0.000884	0.0154
Diflubenzuron:						
Cavefish, Alabama	Channel catfish	370	18.5	Key Cave[a]	—[b]	—[b]
Darter, boulder	Channel catfish	370	18.5	Elk River	0.0000526	0.000757
Darter, slackwater	Channel catfish	370	18.5	Swan Creek, Flint and Buffalo Rivers[a]	0.0013	0.0022
Darter, snail	Channel catfish	370	18.5	Paint Rock River[a]	0.000034	0.00163
Shiner, Cahaba	Channel catfish	370	18.5	Cahaba River	0.000038	0.00105
Sturgeon, Gulf	Channel catfish	370	18.5	Alabama River	0.0000051	0.0000053
Snail, tulotoma	Channel catfish	370	18.5	Kelly Creek[a]	0.0000218	0.00194
Mussel, inflated heelsplitter	Channel catfish	370	18.5	Alabama River	0.0000051	0.0000053
Mussel, Judge Tait's	Channel catfish	370	18.5	Sipsey River[a]	0.0000185	0.00142
Mussel, Marshall's	Channel catfish	370	18.5	Tennessee River	0.000015	0.000016
Mussel, penitent	Channel catfish	370	18.5	Alabama River	0.0000051	0.0000053
Pearly mussel, Alabama lamp	Channel catfish	370	18.5	Paint Rock River[a]	0.000034	0.00163
Pearly mussel, orange-footed	Channel catfish	370	18.5	Tennessee River[a]	0.000015	0.000016
Pearly mussel, pale lilliput	Channel catfish	370	18.5	Paint Rock River[a]	0.000034	0.000163

Table B-3. Approximation of Acute Risk to Endangered, Threatened, and Proposed Fish and Mollusk Species in Streams, Headwaters, or Rivers That Receive Contaminated Runoff and Drift From Program Chemicals in Alabama (continued)

Endangered, threatened, or proposed species	Common species	LC_{50} (mg/L)	1/20 LC_{50} (mg/L)	Representative habitat	EEC (mg/L) Typical	EEC (mg/L) Extreme
Pearly mussel, pink mucket	Channel catfish	370	18.5	Tennessee River[a]	0.000015	0.000016
Pigtoe, fine-rayed	Channel catfish	370	18.5	Tennessee, Elk, and Paint Rock Rivers[a]	0.000053	0.00076
Pigtoe, rough	Channel catfish	370	18.5	Tennessee River[a]	0.000015	0.000016
Pigtoe, shiny	Channel catfish	370	18.5	Paint Rock River[a]	0.000034	0.00163
Methyl parathion:						
Cavefish, Alabama	Yellow perch	3.06	0.153	Key Cave[a]	—[b]	—[b]
Darter, boulder	Yellow perch	3.06	0.153	Elk River[a]	0.00024	0.0031
Darter, slackwater	Yellow perch	3.06	0.153	Swan Creek, Flint and Buffalo Rivers[a]	0.005	0.078
Darter, snail	Yellow perch	3.06	0.153	Tennessee River[a]	0.000059	0.000066
Shiner, Cahaba	Yellow perch	3.06	0.153	Cahaba River[a]	0.00016	0.0042
Sturgeon, Gulf	Yellow perch	3.06	0.153	Alabama River[a]	0.000263	0.000307
Snail, tulotoma	Yellow perch	3.06	0.153	Kelly Creek[a]	0.000122	0.00778
Mussel, inflated heelsplitter	Yellow perch	3.06	0.153	Alabama River	0.000263	0.000307
Mussel, Judge Tait's	Yellow perch	3.06	0.153	Sipsey River[a]	0.000756	0.00569
Mussel, Marshall's	Yellow perch	3.06	0.153	Tennessee River[a]	0.000058	0.0000676
Mussel, penitent	Yellow perch	3.06	0.153	Alabama River[a]	0.000263	0.000307
Pearly mussel, Alabama lamp	Yellow perch	3.06	0.153	Paint Rock River[a]	0.000145	0.00654
Pearly mussel, orange-footed	Yellow perch	3.06	0.153	Tennessee River[a]	0.000058	0.000067

Table B-3. Approximation of Acute Risk to Endangered, Threatened, and Proposed Fish and Mollusk Species in Streams, Headwaters, or Rivers That Receive Contaminated Runoff and Drift From Program Chemicals in Alabama (continued)

Endangered, threatened, or proposed species	Common species	LC_{50} (mg/L)	1/20 LC_{50} (mg/L)	Representative habitat	EEC (mg/L)	
					Typical	Extreme
Pearly mussel, pale lilliput	Yellow perch	3.06	0.153	Paint Rock River[a]	0.000145	0.00654
Pearly mussel, pink mucket	Yellow perch	3.06	0.153	Tennessee River[a]	0.000059	0.000066
Pigtoe, fine-rayed	Yellow perch	3.06	0.153	Tennessee, Elk, and Paint Rock Rivers[a]	0.000287	0.000347
Pigtoe, rough	Yellow perch	3.06	0.153	Tennessee River[a]	0.000058	0.00066
Pigtoe, shiny	Yellow perch	3.06	0.153	Paint Rock River[a]	0.000145	0.000654

[a] Actual habitat area.
[b] Not available; the representative habitat could not be modeled using the GLEAMS methodology.
[c] Exceeds EPA (1986) risk criterion of 1/20 LC_{50} for endangered species.

Table B-4. Approximation of Acute Risk to Endangered, Threatened, and Proposed Aquatic Reptiles in Streams, Headwaters, or Rivers That Receive Contaminated Runoff and Drift From Program Chemicals in Alabama

Endangered, threatened, or proposed species	Indicator species	LC_{50} (mg/L)	1/20 LC_{50} (mg/L)	Representative habitat	EEC (mg/L)	
					Typical	Extreme
Malathion:						
Turtle, Alabama red-bellied	Tadpole (Western chorus frog)	0.2[a]	0.01	Alabama River	0.000168	0.00206
Turtle, flattened musk	Tadpole (Western chorus frog)	0.2	0.01	Alabama River	0.000168	0.00206
Diflubenzuron:						
Turtle, Alabama red-bellied	Channel catfish	370[b]	18.5	Alabama River	0.0000051	0.0000053
Turtle, flattened musk	Channel catfish	370	18.5	Alabama River	0.0000051	0.0000053
Methyl parathion:						
Turtle, Alabama red-bellied	Tadpole (Western chorus frog)	3.7[a]	1.85	Alabama River	0.000263	0.000307
Turtle, flattened musk	Tadpole (Western chorus frog)	3.7	1.85	Alabama River	0.000263	0.000307

[a] Mayer and Ellersieck, 1986.
[b] Julin and Sanders, 1978.

Note: None of the EECs exceeds EPA (1986) risk criterion of 1/20 LC_{50} for endangered aquatic reptile species.

of the decision-tree questions discussed in the risk analysis section and describes the manner in which a species might be impacted. Management strategies or protection measures are then prescribed to prevent those impacts. The "Conclusion" section contains a finding of "no effect" or "may affect."

The protection measures suggested for endangered, threatened, and proposed species in Alabama include prohibiting specific chemicals near some habitat areas, restricting the mode and proximity of application, and limiting the amount of cotton sprayed at any one time in a given watershed of concern.

In the aquatic species risk assessment, malathion in runoff posed significant risks to endangered, threatened, and proposed fish species. The other program insecticides, diflubenzuron and methyl parathion, posed no risk to fish or other endangered, threatened, or proposed aquatic species, even in extreme scenarios. Eliminating runoff is a difficult task, but the risk may be reduced by avoiding malathion use near sensitive species' habitat. In addition, best crop management practices, such as contour plowing, that decrease runoff would be strongly encouraged. However, in watersheds where a relatively large percentage of the total area is devoted to cotton production, the choice of methyl parathion and diflubenzuron instead of malathion may be appropriate.

Restricting the mode of application and its proximity to sensitive habitat can reduce the effects of pesticide drift on terrestrial and aquatic species. The drift model used to determine insecticide exposures to sensitive species also can be used to determine how close treatments may be applied while preventing a significant concentration of insecticide at the presumed species location. Because ground application methods produce much less drift than aerial methods, they may be permissible in areas where aerial applications are inappropriate.

Another potentially useful protection measure for aquatic species is limiting the total quantity of cotton treated at any one time in a watershed containing known endangered, threatened, and proposed species habitat. This protection measure would reduce the total insecticide concentration in the watershed at any one time and would allow flexibility in choosing the appropriate insecticide. Such flexibility is needed in northern Alabama counties where cotton production constitutes a higher percentage of the total land area than in the remainder of the State. Though these counties represent only a small fraction of the cotton-producing counties in Alabama, many of them contain endangered, threatened, and proposed species habitat.

No Effect

Peromyscus polionotus ammobates—**Alabama beach mouse**

Status. The Alabama beach mouse was listed as endangered on June 6, 1985 (50 FR 23884, June 6, 1985).

Description. A subspecies of the oldfield mouse *(Peromyscus polionotus)*, the Alabama beach mouse has a small body, haired tail, relatively large ears, and protuberant eyes. Its head and body length are 2.7 to 3.4 inches (7 to 9 cm), with a tail length of 1.6 to 2.3 inches (4 to 6 cm). The upper body is pale gray, the sides and underparts are white, and the tail is white with an incomplete dorsal stripe.

Habits. Few life history data are available on this subspecies. However, available data indicate that the Alabama beach mouse feeds mostly on beach grass and sea oats—and on invertebrates, especially in late winter and early spring. The mouse seems to be monogamous as long as both partners remain alive, producing litters about once a month. The litter size ranges from two to seven, averaging about four, with the young reaching reproductive maturity as early as 6 weeks of age. The life span for a related species was estimated at 5 months. The Alabama beach mouse is seminomadic over a relatively small range, digging as many as 20 burrows into the sand dunes for nesting, food storage, and safety refuges from predators (Fish and Wildlife Service, 1987).

Habitat. The Alabama beach mouse is found on coastal dunes from Fort Morgan to Alabama Point in Baldwin County, Alabama. The federally designated critical habitat (effective June 6, 1985) includes three areas: a portion of Fort Morgan State Park, a portion of Bon Secour National Wildlife Refuge, and a portion of Gulf State Park—all in Baldwin County, Alabama.

Factors in Species Decline. This mouse has declined in numbers because of habitat destruction caused by residential and commercial development and tropical storms. Predation by domestic and feral cats may also be a factor (FWS, 1987).

Recovery Plan. The goal of the recovery plan is to downlist the Alabama beach mouse to threatened. This subspecies can be considered for reclassification to threatened when there are three distinct, self-sustaining populations in each critical habitat area and when 50 percent of the critical habitat is protected and occupied by mice. The achievement of these goals includes protecting existing habitat on publicly owned land and negotiating with private landowners to protect privately owned habitat, including relocating beach trails and building boardwalks. Research will be necessary to determine the subspecies' life history, habitat needs, and genetic variability for translocation purposes. A public information program will help inform citizens about the Alabama beach mouse and the need for sanitation practices around homes, garbage collection, confinement of domestic cats, a feral cat removal program, and beach-monitoring activities. The subspecies may be considered in the future for downlisting to threatened, but because of extensive and permanent habitat loss, it is unlikely that the subspecies can ever be removed entirely from protection (FWS, 1987).

Analysis of Program Impacts. The Alabama beach mouse should not be affected by the boll weevil program because cotton is not grown in or near the coastal dune habitat where the mouse is found. It should not be exposed to any insecticides either directly, from spray drift, or through its food.

Conclusion. No effect.

***Peromyscus polionotus trissyllepsis*—Perdido Key beach mouse**

Status. The Perdido Key beach mouse was listed as endangered on June 6, 1985 (50 FR 23884, June 6, 1985).

Description. A subspecies of the oldfield mouse *(Peromyscus polionotus)*, the Perdido Key beach mouse has a small body, haired tail, relatively large ears, and protuberant eyes. Its head and body length are 2.7 to 3.3 inches (7 to 8 cm), with a tail length of 1.8 to 2.1 inches (4.5 to 5 cm). The upper body is pale grayish fawn to wood brown with a yellowish hue, the sides and underparts are white, and the tail is white to pale grayish brown with no dorsal stripe.

Habits. Few life history data are available on the subspecies. However, available data indicate that the Perdido Key beach mouse feeds mostly on beach grass and sea oats—and on invertebrates, especially in late winter and early spring. This mouse seems to be monogamous as long as both partners remain alive, producing litters about once a month. The litter size ranges from two to seven, averaging about four, with the young reaching reproductive maturity as early as 6 weeks of age. The life span for a related species was estimated at 5 months. The Perdido Key beach mouse is seminomadic over a relatively small range, digging as many as 20 burrows into the sand dunes for nesting, food storage, and safety refuges from predators.

Habitat. The Perdido Key beach mouse is found on coastal dunes at Gulf Islands National Seashore and Gulf State Park, both on Perdido Key, extending along the Gulf Coast of Baldwin County, Alabama, and Escambia County, Florida. The federally designated critical habitat (effective June 6, 1985) includes three areas: a portion of Perdido Key State Preserve and a portion of Gulf Islands National Seashore— both in Escambia County, Florida—and a portion of Gulf State Park in Baldwin County, Alabama. Because of severe habitat loss following a 1979 hurricane, the Perdido Key beach mouse may be one of the most critically endangered mammals in the United States.

Factors in Species Decline. This mouse population has declined because of habitat destruction caused by residential and commercial development and tropical storms. Predation by domestic and feral cats may have also contributed to the decline (FWS, 1987).

Recovery Plan. The goal of the recovery plan is to downlist the Perdido Key beach mouse to threatened. This subspecies can be

considered for reclassification to threatened when there are three distinct, self-sustaining populations in each critical habitat area and when 50 percent of the critical habitat is protected and occupied by mice (FWS, 1987). The achievement of these goals includes protecting existing habitat on publicly owned land and negotiating with private landowners to protect privately owned habitat, including relocating beach trails and building boardwalks. Research will be necessary to determine the subspecies' life history, habitat needs, and genetic variability for translocation purposes. Finally, the public should be informed about beach mice and their habitat needs, including the need for sanitation practices around homes, increased garbage collection, confinement of domestic cats and a feral cat removal program, and citizen involvement in beach-monitoring activities. The subspecies may be considered in the future for downlisting to threatened, but because of extensive and permanent habitat loss, it is unlikely that the subspecies can ever be removed entirely from protection.

Analysis of Program Impacts. The Perdido Key beach mouse should not be affected by the boll weevil program because cotton is not grown in or near the coastal dune habitat where the mouse is found. It should not be exposed to any insecticides either directly, from spray drift, or through its food.

Conclusion. No effect.

***Phaeognathus hubrichti*—Red Hills salamander**

Status. This species was listed as threatened on January 3, 1977 (41 FR 53034, December 3, 1976).

Description. The Red Hills salamander attains a maximum length of 8.9 inches (225 mm) and is recognizable by its elongated body, short limbs, and prehensile tail. The species is uniformly dark gray to darkish brown (FWS, 1983a).

Habits. Forest arthropods are the common food sources for the Red Hills salamander. Given the abundance of these prey species, competition for food is believed to be unimportant. The reproductive patterns of the Red Hills salamander are unknown. Predation is also unknown, but possible predators include shrews and snakes (FWS, 1983a).

Habitat. The Red Hills salamander prefers rivers or large streams in mesic ravine slopes and bluffsides dominated by hardwood trees. These areas typically have siltstone outcrops and an abundance of arthropods. The species is found only in the Tallahatta and Hatchitigbee formations of Alabama's Red Hills. Currently, an estimated 22,200 acres (9,000 hectares) of habitat remain in this region, including portions of Monroe, Conecuh, Butler, Covington, and Crenshaw Counties (FWS, 1983a).

Factors in Species Decline. The Red Hills salamander is a highly specialized species with low vagility and an apparently low reproductive potential. Consequently, the species is very sensitive to habitat alteration. Major human disturbances, particularly clearcutting forestry operations, pose the greatest threat to the salamander's viability (FWS, 1983a).

Recovery Plan. The ultimate recovery goal is to remove the Red Hills salamander from the endangered and threatened species list. The immediate goal, however, is to prevent the decline to endangered status. The plan includes the assessment of the salamander's preferred habitat (including land use and ownership), the study of population biology and ecology, and the preservation and management of current habitat (FWS, 1983a).

Analysis of Program Impacts. The boll weevil program should not affect the Red Hills salamander. Because the species' preferred habitat occurs in timber stands or regeneration stands along ravines that are too steep for croplands (according to a personal communication with W. Neal), no boll weevil treatments are likely to occur close enough to the species' habitat to affect it or its food sources.

Conclusion. No effect.

Cottus pygmaeus—**Pygmy sculpin**

Status. The pygmy sculpin was listed as a threatened species on October 30, 1989 (54 FR 39849, September 28, 1989).

Description. The pygmy sculpin rarely exceeds a total length of 1.8 inches (4.6 cm). Its head is large, and its lateral line is incomplete. Although the body coloration varies by sex, maturity, and breeding condition, pigmentation is usually consistent (Williams, 1968; as cited in 54 FR 39849, September 28, 1989). The body pigmentation consists of about three dorsal saddles and mottled or spotted fins. Juveniles possess a grayish-black body with three light-colored saddles, and their heads are black. In adults, the body color becomes lighter, with the grayish-black color forming two dark saddles, and the head becomes white with small, scattered melanophores. During the breeding season, the dark spots on the spinous dorsal fin of males enlarge and become more intense while the fin margin becomes reddish orange. Also, the body becomes suffused with black pigment that nearly conceals the underlying color pattern. The body color of breeding females is usually slightly darker than in nonbreeding females (54 FR 39849, September 28, 1989).

Habits. The pygmy sculpin prefers spring run areas containing a sand and gravel substrate with large rocks. These areas also contain large mats of vegetation (54 FR 39849, September 28, 1989). No information was available on the pygmy sculpin's dietary habits.

Habitat. The only known population of *C. pygmaeus* occurs in Coldwater Spring and its associated spring run in Calhoun County, Alabama. The spring is impounded to form a 2- to 4-foot-deep pool that covers about an acre (McCaleb et al., 1973; as cited in 54 FR 39849, September 28, 1989). Below the pool, the spring run is as much as 60 feet (18.3 m) wide and 500 feet (152.4 m) long until it joins Dry Creek. Discovered in 1963, the species has never been recorded below the confluence of the spring run and Dry Creek, and it is uncertain whether the historic range of this species was larger in earlier years (54 FR 39849, September 28, 1989).

Factors in Species Decline. Although the City of Anniston, Alabama, owns the entire habitat area and uses Coldwater Spring as its primary water supply, the degradation of water quality in the Coldwater Spring area is the major threat to the pygmy sculpin. Several potential sources of water contamination—including an army depot, an army fort, a chemical manufacturing industry, the City of Anniston, and at least one landfill—lie within the spring's 90 square mile (145 km^2) recharge area. For example, hexavalent chromium from the army depot has been discharged into Dry Creek, and chlorinated hydrocarbons have been found in groundwater at the depot. Although such chemicals have not yet been found in Coldwater Spring, they may be migrating in the local aquifer and thus may present a long-term threat to the species. Another threat to the species is a proposed highway construction project. This construction through the Coldwater Spring recharge area could alter groundwater flow patterns, and any accidental spillage of toxic substances during the construction could contaminate the spring (54 FR 39849, September 28, 1989)

Recovery Plan. None.

Analysis of Program Impacts. The pygmy sculpin's only known habitat area is protected by the Anniston Water Works and Sewer Department, and most of the surrounding land is used for non-agricultural purposes. The cotton acreage in the Coldwater Spring recharge area, if any, is thus relatively minor. Consequently, the species will not be exposed to any of the boll weevil control program insecticides.

Conclusion. No effect.

***Etheostoma nuchale*—Watercress darter**

Status. The watercress darter was listed as endangered on October 13, 1970 (35 FR 16047, October 13, 1970).

Description. This darter's maximum length is 2 inches (5.1 cm). It is recognized by its bulging nape. Breeding males have a red-orange belly as well as red-orange and blue fins; the females have less colorful breeding colors (FWS, 1984a; Ono et al., 1983).

Habits. The species feeds on the aquatic insects, crustaceans, and snails found in thick aquatic vegetation (FWS, 1984j). Females carry ripe eggs from March through July, the approximate period of the male's display of breeding colors. However, little else is known about the reproductive patterns (Ono et al., 1983).

Habitat. Deep, slow-moving backwaters of springs filled with dense growths of aquatic vegetation are the watercress darter's usual habitat. Glenn, Roebuck, and Thomas' Springs in Jefferson County, Alabama, are the only known remaining habitats (FWS, 1984a).

Factors in Species Decline. Habitat alteration and pollution are the major contributors to the watercress darter's decline. Both the Glenn and Roebuck Springs populations have been damaged by high coliform bacteria counts, and sewage from nearby septic tanks is a possible source of the contamination. Also, construction projects in Jefferson County have altered the drainage patterns and, ultimately, the recharge potentials for the three springs (FWS, 1984a).

Recovery Plan. The reclassification of the watercress darter from an endangered to a threatened species is the primary objective of the recovery plan. For reclassification to occur, the long-term protection of the known populations and their habitats must be documented, the populations must be shown to be stable or expanding over a 5-year period, and at least one new population must be established within the historic range (FWS, 1984a).

Analysis of Program Impacts. Jefferson County, Alabama, is not a cotton-producing county.

Conclusion. No effect.

***Phyllitis scolopendrium* var. *americana*—American hart's-tongue fern**

(The FWS recognizes *Phyllitis japonica* Kom. ssp. *americana* Love and Love as equivalent to *Phyllitis scolopendrium* var. *americana*.)

Status. The American hart's-tongue fern was listed as threatened on July 14, 1989 (54 FR 29730, July 14, 1989).

Description. The American hart's-tongue fern has evergreen, strap-shaped fronds that are 5 to 17 inches long. The green petiole is 1 to 5 inches long and covered with cinnamon scales. Sori are linear and occur on the underside of the frond.

Habits. The fronds arise in a cluster from a short creeping rhizome.

Habitat. The fern is usually found growing on or near dolomitic limestone. The fern appears to prefer moist soil, shade, and high humidity. The species is found in Jackson and Morgan Counties in Alabama. These populations are associated with caves or sinkholes.

The Fish and Wildlife Service's "Counties of Occurrence" list shows this species to be present only in Morgan County, Alabama.

Factors in Species Decline. The fern is threatened throughout most of its range by trampling, habitat alteration, or destruction of habitat by logging, residential development, or quarrying.

Recovery Plan. None.

Analysis of Program Impacts. Although the American hart's-tongue fern is located in a cotton-producing county, the species will not be directly or indirectly affected by the boll weevil control program because it reproduces by spores, a form of reproduction that does not require insect pollinators.

Conclusion. No effect.

***Sarracenia rubra* ssp. *alabamensis*—Alabama canebrake pitcher-plant**

Status. The Alabama canebrake pitcher-plant was listed as endangered on April 10, 1989 (54 FR 10154, March 10, 1989).

Description. This species is a carnivorous herb of the pitcher-plant family (*Sarraceniaceae*). This species produces two types of pitchers, or hollow leaves, each year. Spring pitchers appear with the maroon flowers. Summer pitchers are larger, distinctively shaped, puberulent, yellow-green, and inconspicuously veined and aeroluate in the upper portion. The fruit of the plant is a capsule.

Habits. The plant flowers from late April to early June.

Habitat. The species occurs in sandhill seeps, swamps, and bogs along the fall line of central Alabama. Soils are acidic, highly saturated, and peaty sand or clay. The species is endemic to Autauga, Chilton, and Elmore Counties in central Alabama.

Factors in Species Decline. Population decline of this species has been the result of habitat destruction, succession due to inhibition of fire, overcollecting, and adverse land-use practices. Increased agricultural use of the area has resulted in draining of some of the species habitat.

Recovery Plan. None.

Analysis of Program Impacts. Because the lands adjacent to Alabama canebrake pitcher-plant habitat are currently used for pasture, the boll weevil control program would not affect this species. If the adjacent pasture lands are converted to cotton production, however, consultation will be initiated, if necessary.

Conclusion. No effect.

Sarracenia oreophila—Green pitcher-plant

Status. The green pitcher-plant was listed as endangered on October 21, 1979 (44 FR 54923, September 21, 1979; 45 FR 18929, March 24, 1980).

Description. The green pitcher-plant is a perennial herb with moderately branched rhizomes. The pitcher leaves ascend with the flower buds and mature from late April through May. The pitcher leaves are yellow-green with maroon veining and a hood over the opening. The pitcher leaves wither by midsummer and are replaced by flat, falcate leaves. The yellow flowers occur singly on scapes.

Habits. The pitcher-plant is pollinated by bees. It is insectivorous, and a number of insect species have co-evolved with it. It flowers from late April through May.

Habitat. The green pitcher-plant may grow in three habitat types. It can be found in mixed-oak flatwoods where there is flat relief and poor drainage. Another habitat is seepage bogs or areas with boggy spring heads. These bog areas have variable-canopy vegetation. The third habitat is sandstone stream banks or sandy, rocky banks. This is the only *Sarracenia* species found outside the Coastal Plain. It is found only in Cherokee, Dekalb, Etowah, Jackson, and Marshall Counties in Alabama.

Factors in Species Decline. Degradation of populations and habitats have resulted from increased urban and agricultural development. Commercial and amateur collecting also have contributed to its decline. Other colonies have been lost to floods and streambank erosion (FWS, 1985a).

Recovery Plan. The primary objective of the recovery plan is to delist the green pitcher-plant as an endangered species. Actions toward this goal include protecting existing colonies from taking, reestablishing colonies at extirpated sites, and increasing public education. The species will be considered recovered when 15 colonies are protected and managed to ensure their continued existence (FWS, 1985a).

Analysis of Program Impacts. Although the green pitcher-plant is located in cotton-producing counties, it is unlikely to be directly or indirectly affected by the boll weevil control program because it is presently restricted to seepage bogs and flatwoods, areas that are not conducive to cotton production.

Conclusion. No effect.

***Lesquerella lyrata*—Lyrate bladder-pod**

Status. The lyrate bladder-pod was proposed for listing as a threatened species on April 25, 1990 (55 FR 17552, April 25, 1990).

Description. The lyrate bladder-pod is an annual that ranges from 4 to 12 inches (10 to 30 cm) in height. Plants are shortly pubescent and usually branched near the base. The stem leaves are alternate, oval to elliptic in shape, smooth or toothed on the margins, with prominent ear-like projections at the bases. The flowers are ascending, on stalks 0.39 to 0.59 inches (10 to 15 mm) long, with yellow petals 0.2 to 0.26 inches (5 to 7 mm) in length. The fruits are siliques, globose in shape, 0.1 to 0.14 inches (2.5 to 3.5 mm) long and 0.12 to 0.16 inches (3 to 4 mm) wide (Rollins and Shaw, 1973; McDaniel, 1987; both as cited in 55 FR 17552, April 25, 1990).

Habits. The lyrate bladder-pod flowers from March to April, bears fruit during this time, and disperses seeds in late April or May. It is dormant in the summer, surviving as seeds, germinates in the fall, and overwinters as a rosette (J. Baskin, 1989; as cited in 55 FR 17552, April 25, 1990).

Habitat. The lyrate bladder-pod is a component of glade flora and occurs in association with limestone outcroppings. The terms "glade" and "cedar glade" refer to shallow-soiled open areas that are sometimes surrounded by cedar woods. Under natural conditions, the plant is an early successional species that colonizes shallow cedar glade soils and then slowly disappears as the soil layer further develops. This species is a poor competitor and is eliminated by shade and competition from invading perennials. Because of the continuing loss of cedar glades in its native habitat range, the presently available habitat for the plant is limited to areas modified by human activity. Periodic disturbance of the soil arrests succession and brings seeds to the surface, which facilitates germination (Baskin, 1989; Webb and Lyons, 1984; both as cited in 55 FR 17552, April 25, 1990). The two known remaining populations of the species occur in Franklin and Colbert Counties, Alabama. These two populations are located primarily on gladelike areas that exhibit various degrees of disturbance, including unimproved pastures, cultivated and plowed fields, and roadside rights-of-way (55 FR 17552, April 25, 1990).

Factors in Species Decline. The cedar glade systems in Alabama have been and continue to be modified by agricultural development, housing development, and garbage dumping (Kral, 1983; as cited in 55 FR 17552, April 25, 1990). Although periodic disturbances from the plowing of row crops are helpful in maintaining populations of *L. lyrata*, plowing or herbicide use during the spring before seed set and dispersal may affect the species. Although populations located in pastures may be enhanced by light grazing, heavy grazing causes excessive soil compaction that may affect the plant. Because the species has only a

limited range and only a few surviving populations, the greatest threat to the species is its extreme vulnerability to further habitat modification (55 FR 17552, April 25, 1990).

Recovery Plan. None.

Analysis of Program Impacts. The flowering stage of the lyrate bladder-pod's life cycle occurs before the initiation of insecticide use in the Alabama control program, and the species is dormant during the summer. Consequently, it is unlikely that the program will have any direct effects on the species or any indirect effects through the temporary reduction of insect pollinators.

Conclusion. No effect.

***Apios priceana*—Price's potato-bean**

Status. Price's potato-bean was listed as a threatened species on February 5, 1990 (55 FR 433, January 5, 1990).

Description. *Apios priceana* is a twining perennial vine which climbs up to 5 meters from a single, large thickened tuber. Leaves are alternate, pinnately compound with five to seven leaflets that are ovate lanceolate to broadly ovate in shape and glabrous to short-hairy beneath. The flowers are borne in the leaf axils and consist of peduncled racemes or compact pinnacles, 2 to 6 inches (5 to 15 cm) long. Individual flowers are about 0.75 inches (2 cm) long and are greenish white tinged with purplish pink toward the tip (55 FR 433, January 5, 1990).

Habits. Flowering occurs from mid-June through August, with fruits present from late August through September (Kral, 1983; Medley, 1980; Woods, 1988; all as cited in 55 FR 433, January 5, 1990).

Habitat. Price's potato-bean occurs in the open areas of mixed hardwood forests and is commonly associated with *Quercus muhlenbergii, Lindera benzoin, Campanula americana, Arundinaria gigantea, Tilia americana, Fraxinus americana, Acer saccharum, Ulmus rubra, Cerciscanadensis,* and *Parthenocissus guinguefolius* (Medley, 1980; as cited in 55 FR 433, January 5, 1990). Also, populations occur in open woods and along wood edges in limestone areas, often where river bluffs grade into creek or river bottoms (Kral, 1983; Medley, 1980; both as cited in 55 FR 433, January 5, 1990). Populations may extend onto roadside or power line rights-of-way. Soils are described as well-drained loams on old alluvium or over limestone (Kral, 1983; as cited in 55 FR 433, January 5, 1990). Currently, this species is known to exist at only 13 sites with populations in Alabama, Kentucky, Mississippi, and Tennessee. Alabama has two populations of 15 to 30 individuals located in Madison County and Autauga County, respectively. A third population of less than five individuals exists in Marshall County (Medley, 1980; as cited in 55 FR 433, January 5, 1990).

Factors in Species Decline. *Apios priceana* is currently or potentially jeopardized by habitat modification, including cattle grazing and trampling, clearcutting, excessive shading and competition from weeds during succession, and the use of herbicides in roadsides or power line rights-of-way maintenance (55 FR 433, January 5, 1990).

Recovery Plan. None.

Analysis of Program Impacts. Although the species occurs in cotton-growing counties, Price's potato-bean's preferred habitat of open woods does not support cotton production. Therefore, it is unlikely that any control program activities will adversely affect the species. However, some habitat areas lie adjacent to cattle grazing areas; and if these grazing lands are converted to cotton production, consultation will be initiated, if necessary.

Conclusion. No effect.

***Dalea foliosa*—Leafy prairie-clover**

Status. The leafy prairie-clover was proposed for listing as an endangered species on March 27, 1990 (55 FR 11230, March 27, 1990), and was listed on May 1, 1991 (56 FR 19953, May 1, 1991).

Description. The leafy prairie-clover is a perennial whose stems stands approximately 20 inches (0.5 m) tall above a hardened root crown. The plant's pinnately compound alternate leaves are 1.4 to 1.8 inches (3.5 to 4.5 cm) long and are composed of 20 to 30 leaflets. Small purple flowers are borne in dense spikes at the end of the stems (Smith and Wofford, 1980; as cited in 55 FR 11230, March 27, 1990).

Habits. Flowering begins in late July and continues through August. Seeds ripen by early October, and the aboveground portion of the plant dies soon afterward. The dead stems remain erect and disperse ripened seeds from late fall to early spring (Baskin and Baskin, 1973; as cited in 55 FR 11230, March 27, 1990).

Habitat. The leafy prairie-clover is typically found growing in close association with the cedar glades of central Tennessee and northern Alabama. However, the species apparently prefers the deeper soil of the prairie-like areas along the boundaries of and within the rocky cedar glades of the region (Smith and Wofford, 1980; as cited in 55 FR 11230, March 27, 1990). In Alabama, one population is known to exist in Morgan County.

Factors in Species Decline. In general, the leafy prairie-clover is threatened throughout its range by habitat alteration, including residential, industrial, and commercial development, livestock grazing, and the conversion of land to pasture areas. In addition to these factors, the leafy prairie-clover is threatened by the encroachment of more competitive herbaceous vegetation and woody plants and the drought in the

species' habitat during the past 3 years (1987-89). It is believed that this lack of moisture is a factor in the species' low reproductive rate (55 FR 11230, March 27, 1990).

Recovery Plan. None.

Analysis of Program Impacts. Only Rutherford County in Tennessee and Morgan County in Alabama are cotton-producing counties containing populations of the leafy prairie-clover. However, the program will have no effect on the species because the Tennessee population is located in a state park and the Alabama population is adjacent to livestock grazing areas (55 FR 11230, March 27, 1990). If the grazing areas are converted to cotton production, consultation will be initiated, if necessary.

Conclusion. No effect.

***Amphianthus pusillus*—Little amphianthus**

Status. Little amphianthus was listed as threatened on March 7, 1988 (53 FR 3565, February 5, 1989).

Description. Little amphianthus is a small fibrous-rooted annual of the snapdragon family. The plant has dimorphic leaves and flowers. Submerged leaves are lanceolate and in a basal rosette. Floating leaves are ovate with long delicate stems. The flowers are white and 0.01 inches (4 mm) wide. Floating flowers are open and submerged flowers are closed. The fruit is a capsule.

Habits. Little amphianthus flowers in March or April. It is ephemeral and completes its life cycle in 3 to 4 weeks. Its population size and vigor depend on moisture. Little is know about its pollinators.

Habitat. This species is found in pools surrounded by a rock rim in sandy-silty soils. It is endemic to granite outcrops in the Piedmont physiographic region. It prefers large isolated domes or gently rolling flatrocks. These areas usually have high light intensities and extreme wet and dry periods. The Fish and Wildlife Service's "Counties of Occurrence" list shows this plant is present in Chambers and Randolph Counties, Alabama.

Factors in Species Decline. Little amphianthus has declined because of habitat destruction caused by quarrying and eutrophication of pools from cattle and recreation.

Recovery Plan. None.

Analysis of Program Impacts. Although the little amphianthus is located in cotton-producing areas, the species' flowering period does not correspond with the insecticide treatment periods scheduled for the control program. For this reason, the program will have no direct

effects on the species or any indirect effects through the temporary reduction of insect pollinators.

Conclusion. No effect.

May Affect

***Myotis grisescens*—Gray bat**

Status. The gray bat was listed as endangered on April 28, 1976 (41 FR 17740, April 28, 1976).

Description. The gray bat is the largest member of its genus in the eastern United States. Its forearm measures 1.5 to 1.8 inches (40 to 46 mm), and it weighs from 0.3 to 1 ounce (7 to 16 g). It is easily distinguished from all other bats within its range by its unicolored dorsal fur, because all other eastern bats have distinctly bi- or tricolored fur on their backs. Following molt in June or July, gray bats are dark gray, but they often bleach to chestnut brown or russet between molts, especially reproductive females during May and June. The wing membrane connects to the foot at the ankle rather than at the base of the first toe, as in other species of *Myotis* (FWS, 1982a).

Habits. Gray bats feed on insects. During peak insect abundance in early evening, many gray bats feed in slowly traveling groups, but when insect activity subsides 1 to 2 hours after sundown, the bats become territorial. Depending on prey abundance, foraging territories may be occupied by from 1 to as many as 15 or more bats. Territories seem to be controlled by reproductive females and are located in the same places and used by the same individual bats from one year to the next. Most migrate seasonally between hibernating caves and maternity caves. On arrival at hibernating caves, the adults mate, and the females immediately begin hibernation, some as early as the first of September and nearly all by early October. Following mating, the males remain active for several weeks, during which time fat supplies depleted during breeding are replenished. The juveniles of both sexes and adult males tend to enter hibernation several weeks later than the adult females, but most are in hibernation by early November. Stored fat reserves must last for at least 6 to 7 months. The adult females store sperm throughout the winter months and become pregnant soon after they emerge from hibernation. The adult females emerge in late March or early April, followed by the juveniles of both sexes and the adult males. Migration is hazardous, especially in spring when fat reserves and food supplies are low. Consequently, adult mortality is especially high in late March and in April. The pregnant females give birth to a single young in late May or early June. At that time, the reproductively active females congregate in a single, traditional maternity cave (usually the warmest one available), while males and nonreproductive females congregate in smaller groups in more peripheral caves within the colony home range. Most young begin to fly 20 to 25 days after birth. Each summer colony occupies a traditional home range that often contains several roosting caves scattered along as much as 43.5 miles (70 km) of river or reservoir borders. Colony members

are extremely loyal to their colony home range, but they tend to disperse in groups among several different caves within that area.

Habitat. Most winter caves are deep and vertical; all provide large volume below the lowest entrance and act as cold air traps. A much wider variety of cave types are used during the spring and fall transient periods. In summer, maternity colonies prefer caves that act as warm air traps or that provide restricted rooms or domed ceilings that are capable of trapping the combined body heat from thousands of clustered individuals. During all seasons, males and yearling females seem less restricted to specific cave and roof types. Summer caves, especially those used by maternity colonies, are nearly always located within a kilometer of the rivers or reservoirs over which the bats feed. Newly volant young gray bats often feed and take shelter in the forest surrounding the cave entrances. Forested areas surrounding caves and between caves and overwater feeding habitat clearly are advantageous to gray bat survival. The bat is found in limestone karst areas of the Southeast—in Alabama, Arkansas, Missouri, Florida, and Tennessee. There is no federally designated critical habitat for the gray bat. Important habitats in Alabama are Fern and Sauta Caves in Jackson County, Cave Springs Cave in Morgan County, Key Cave in Lauderdale County, Georgetown Cave in Colbert County, Hambrick Cave in Marshall County, and Sanders Cave in Conecuh County. The Fish and Wildlife Service's "Counties of Occurrence" list includes 11 counties in Alabama.

Factors in Species Decline. The reasons for the gray bat decline include human disturbance (entrance into caves during hibernation), environmental disturbance (pesticide use, chemical pollution, siltation of waterways over which gray bats forage, and deforestation leading to increased predation), impoundment of waterways, cave commercialization, improper gating, and natural calamities (cave flooding and cave-ins) (FWS, 1982a).

Recovery Plan. The objective of the recovery plan is to remove the gray bat from endangered status (FWS, 1982a). The criteria for change from endangered to threatened status are documentation of protection of 90 percent of the Priority 1 hibernacula and documentation of stable or increasing populations at 75 percent of Priority 1 maternity caves during a period of 5 years. Once the status has been changed from "endangered" to "threatened," it will be possible to delist this species by the documentation of permanent protection as well as stable or increasing populations during 5 years of 25 percent of Priority 2 caves in each State. The most important feature of this plan is protecting the roosting habitat, but it also includes maintaining, protecting, and restoring the forage habitat and monitoring population trends.

Analysis of Program Impacts. Because they roost in caves during the day and foraging is crepuscular and nocturnal, direct toxic insecticide exposures of gray bats are not likely to occur. Depletion of their insect food supplies could be a problem only if accidental overspraying or

significant drift of insecticides occurred during applications to cotton fields next to the streams, rivers, and lakes where the bats are known to forage. In known foraging areas, risks will be decreased by avoiding aerial applications within 200 feet (61 m) of identified riparian areas. Within this buffer, only ground equipment will be used. Bat colonies roosting in caves could be disturbed by aircraft overflights. To prevent this disturbance, aircraft overflights of identified roosting caves will be avoided. Although direct exposure to malathion or methyl parathion may present a risk to the species, such occurrences are extremely unlikely because the bats spend most of the daylight hours roosting in caves.

Conclusion. May affect.

***Myotis sodalis*—Indiana bat**

Status. The Indiana bat was listed as endangered on March 11, 1967 (32 FR 4001, March 11, 1967).

Description. The Indiana bat is small, with a forearm length of 1.4 to 1.6 inches (35 to 41 mm) and a head and body length of 1.6 to 1.9 inches (41 to 49 mm). It is grayish brown in color, with grayish ears and membranes. It has a keeled calcar and small, delicate hindfeet with short hairs. The young are usually capable of flight within a month of birth.

Habits. Indiana bats seem to feed primarily on *Lepidoptera* and aquatic insects. Most Indiana bats migrate seasonally between winter and summer roosts. On arrival at hibernating caves, swarming occurs, which is described as "a phenomenon in which large numbers of bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in the caves during the day" (Cope and Humphrey, 1977; as cited in FWS, 1983b). Swarming may continue for several weeks. Fat supplies are replenished before hibernation. The males tend to remain active longer at cave entrances during the swarming period than females (LaVal and LaVal, 1980; as cited in FWS, 1983b). After the bats mate, the females enter directly into hibernation, some as early as October. Nearly all the males are hibernating by late November. They usually hibernate in large, dense clusters of about 300 bats per square foot. Presumably, the adult females store sperm through the winter and become pregnant soon after emergence from hibernation. The females emerge in late March or early April, followed by the males. The females give birth to a single young in June or July, at which time they join together in nursery colonies beneath the loose bark of trees. Known maternity colonies occur in riparian habitats, although recent evidence suggests that colonies may also occur in upland habitats. Little is known of the roosting habits of the males, but scattered reports indicate that they disperse throughout the range in summer. The latter part of the summer is spent accumulating fat reserves for fall migration and hibernation.

Habitat. For winter hibernation, Indiana bats require specific roost sites in caves or mines that have stable temperatures below 50°F (10°C), preferably from 39.2 to 46.4°F (4 to 8°C). Only a small percentage of available caves provide the stable low temperatures that allow the bats to maintain a low rate of metabolism and conserve fat reserves until spring (Humphrey, 1978; as cited in FWS, 1983b). Little is known about Indiana bat summer habitat. Recent studies have indicated that maternity colonies are formed mostly in riparian and floodplain areas of small- to medium-sized streams. These bats have also been found in tree-lined drainage ditches and forests. Optimum foraging habitat seems to consist of streams lined on both sides with mature trees that overhang the water by more than 9.8 feet (3 m).

Critical habitats for the Indiana bat are Blackball Mine in LaSalle County, Illinois; Big Wyandotte Cave in Crawford County and Ray's Cave in Greene County, Indiana; Bat Cave in Carter County and Coach Cave in Edmonson County, Kentucky; Cave 201 in Crawford County, Cave 009 and Cave 017 in Franklin County, Pilot Knob Mine in Iron County, Bat Cave in Shannon County, and Cave 029 in Washington County, Missouri; White Oak Blowhole Cave in Blount County, Tennessee; and Hellhole Cave in Pendleton County, West Virginia. Important habitats in the program area are Fern, Sauta, and Nitre Caves in Jackson County, Alabama. The Fish and Wildlife Service's "Counties of Occurrence" list includes 11 counties in Alabama.

Factors in Species Decline. The Indiana bat populations have declined because of natural and human hazards. The natural hazards include the flooding of caves, collapsing of cave ceilings, and dying from freezing in severe winters. Human causes include disturbance (arousal during hibernation causes them to use a significant portion of their fat reserves, making it likely they will leave the cave too soon and die); vandalism (bats often are misunderstood and viewed by many people with fear and repugnance); deforestation; stream channelization without accompanying restoration of riparian forest cover; indiscriminate collecting, handling, and banding of hibernating bats; commercialization of hibernacula; exclusion of bats from caves by poorly designed gates; changes in cave microclimate through the opening of additional entrances or the blocking of air flow by poorly designed gates; and flooding of caves by reservoirs (FWS, 1983b).

Recovery Plan. The objective of the recovery plan is to remove the Indiana bat from endangered status (FWS, 1983b). The most important feature of this plan is to gain control of important hibernacula and protect them from human disturbance. Other features include maintaining, protecting, and restoring foraging and nursery habitat; monitoring population trends; public education; and filling research needs to increase management efficiency. Actions to achieve these objectives include erecting warning signs, gating or fencing the caves, monitoring hibernacula, monitoring caves by law enforcement agencies, discouraging human access, preventing adverse modifications to and rehabilitating the subsurface, preventing adverse modifications to and

rehabilitating the surface watershed surrounding important roost sites, making locations of hibernacula available to appropriate Fish and Wildlife Service officials and State wildlife agencies, identifying all Indiana bat winter and fall roost sites, evaluating roost sites, identifying roost sites to be protected, determining habitat requirements, preserving water quality, restoring and preserving forest cover along rivers and streams, monitoring habitat, monitoring status of populations in hibernacula, monitoring status of populations in summer, and monitoring residues of toxic chemicals in insects and bats.

Analysis of Program Impacts. Direct toxic effects to Indiana bats could occur from a direct spraying of malathion or methyl parathion. Depletion of the bat's food supplies could occur in riparian areas if accidental overspraying or drift were to occur. In known foraging areas, risks will be decreased by avoiding aerial applications within 200 feet (61 m) of identified riparian areas. Within this buffer, only ground equipment will be used. Roosting bat colonies could be disturbed by aircraft overflights. To prevent this disturbance, aircraft overflights of identified roosting areas will be avoided.

Conclusion. May affect.

***Charadrius melodus*—Piping plover**

Status. The Great Lakes watershed population of the piping plover was listed as endangered on January 10, 1986 (50 FR 50733, December 11, 1985). The Atlantic Coast and northern Great Plains populations were listed as threatened on January 10, 1986 (50 FR 50733, December 11, 1985).

Description. The adult piping plovers have a sand-colored body, white undersides, and orange legs. A white wing stripe and white rump are visible during flight. During the breeding season, the adults acquire a black forehead and breast bands. Juvenile plumage is similar to that of the nonbreeding adults. These birds are about 6.7 inches (17 cm) long and weigh 1.6 to 2.4 ounces (45 to 64 g).

Habits. Piping plovers are migratory shorebirds. They arrive in their northern breeding grounds in April or May. Eggs are usually laid in the second or third week of May in a cup nest in the sand, lined with pebbles or shell fragments. Four is the usual clutch size. Chicks are precocial, and the plover leaves the nesting grounds in August. The usual diet consists of marine worms, crustaceans, insects, and mollusks.

Habitat. Nesting occurs in sandflats, saline or alkaline wetlands, and sandbars in the northern plains of Montana, North Dakota, South Dakota, and Nebraska. Piping plovers winter in Mobile and Baldwin Counties, Alabama (FWS, 1988).

Factors in Species Decline. The piping plover's natural habitat is quite ephemeral. Thus, the species is susceptible to nest destruction and,

ultimately, population fluctuations. In addition to this natural loss, sandy beaches have been destroyed as habitat areas by recreational and commercial development. The piping plover is easily disrupted by human disturbances. Hunting also led to a decline in the species in the 19th and early 20th centuries.

Recovery Plan. The goal of the Atlantic Coast Piping Plover Recovery Plan is to double the size of the Atlantic coast population. Steps toward this goal will include managing populations and breeding habitat to maximize productivity, monitoring and managing wintering areas, and further investigating the species' biology (FWS, 1988).

Analysis of Program Impacts. According to the results of the terrestrial wildlife risk assessment, direct exposure to methyl parathion may present a risk to the piping plover. However, the species should not be at risk from insecticide use in the boll weevil program because its habitat preference and feeding habits are not in any way associated with cotton production. The piping plover's migratory and habitat requirements make direct exposure extremely unlikely. But because individual birds may migrate through cotton-producing areas, preference will be given to the use of malathion or diflubenzuron in the identified migratory corridor during the migration period.

Conclusion. May-affect.

***Haliaeetus leucocephalus*—Bald eagle**

Status. The bald eagle was listed as endangered throughout the lower 48 States on March 11, 1967 (32 FR 4001, March 11, 1967). The species was reclassified as threatened in Washington, Oregon, Minnesota, Wisconsin, and Michigan on March 16, 1978 (43 FR 6233, February 14, 1978).

Description. The bald eagle is a large raptor, 30 to 35 inches (76 to 89 cm) long, with a wingspan of 7 feet (2.1 m) and a weight of 8 to 13 pounds (3.6 to 5.9 kg). Adult eagles are dark brown with a white head and tail, and immature eagles are dark brown over their entire bodies (FWS, 1984b).

Habits. Bald eagles generally mate for life, and breeding starts at age 4 or 5. Eagles are territorial during the breeding season; they defend an average territory size of 57 acres (23 hectares) and establish a platform nest of sticks in a tall tree or on a cliff. A female bald eagle lays two eggs; incubation time is usually 35 days; and 10 to 12 weeks are needed for fledging. Bald eagles are opportunistic feeders, and they eat a variety of prey, both living and carrion. Their preferred diet is fish (FWS, 1984b).

Habitat. Bald eagles are found in riparian habitats—rivers, coasts, and lakes. Nesting sites are usually within a half mile of water, in the

largest living tree in a stand, and with an open view of the surrounding area (FWS, 1984b). The Fish and Wildlife Service's "Counties of Occurrence" list includes 11 counties in Alabama.

Factors in Species Decline. Reasons for the eagle's decline include lowered reproductive success because of pesticide residues, loss of habitat, and human disturbances, particularly wanton shooting (FWS, 1984b).

Recovery Plan. The primary objective of the Southeastern States Recovery Plan is to remove the bald eagle from the endangered and threatened list by protecting and managing eagle populations and habitat and improving public support for the recovery plan (FWS, 1984b).

Analysis of Program Impacts. Based on the terrestrial wildlife risk assessment, direct exposure to methyl parathion may present a risk to the bald eagle. However, the other two boll weevil control program insecticides do not present an unreasonable risk to the species. Consequently, the species can be protected by using only malathion or diflubenzuron in known eagle foraging areas. Direct exposure risks can be reduced by avoiding the use of methyl parathion in areas where active nests or roosts are known. Also, disturbance of the species' nests or roosting sites by program activities can be prevented by avoiding overflights and program activities within 300 feet of known nests or roosting sites.

Conclusion. May affect.

***Picoides (=Dendrocopos) borealis*—Red-cockaded woodpecker**

Status. The red-cockaded woodpecker was listed as endangered on October 13, 1970 (35 FR 16047, October 13, 1970).

Description. The red-cockaded woodpecker is small, 7 to 8 inches (18 to 20 cm) long. It has black and white horizontal stripes on its back, white cheeks, and a black cap. In addition, the male has a small red spot on its cheeks (FWS, 1985b).

Habits. This woodpecker builds its nest in an excavated cavity in living pine trees usually infected by red heart disease. These birds are strongly territorial and keep numerous small "wells" of sap running as a cavity defense mechanism. The birds live in a family unit, or clan, of 5 to 10 birds, consisting of a breeding pair and unmated young.

Habitat. The red-cockaded woodpecker is a habitat specialist, nesting in open stands of pines a minimum of 60 years old. A clan requires an average of 200 acres (81 hectares). Currently, the red-cockaded woodpecker is found in 12 States throughout the southeastern and midsouthern United States, and an estimated 2,700 colonies nest on federally owned land.

Factors in Species Decline. The decline of the red-cockaded woodpecker has been facilitated by the loss of habitat and forestry practices that destroy the old-growth pine forests preferred by the species.

Recovery Plan. The ultimate objective of the recovery plan is to maintain viable populations in all physiographic regions and forest types where the species is known to occur. According to the plan, all forests with adequate acreage should sustain minimum populations of 250 clans, while smaller properties should maintain populations for the highest sustainable densities (FWS, 1985b).

Analysis of Program Impacts. Because the red-cockaded woodpecker establishes colonies and forages in old-growth pine stands, the species should not be exposed to any of the boll weevil control program insecticides. Although direct exposure to malathion or methyl parathion may present an unacceptable risk to the woodpecker, the species habitat requirements make such an occurrence unlikely. However, in the instance where a nest or colony is established in a pine stand adjacent to a cotton field, the potential risk to the species will be lessened by avoiding aerial applications within 200 feet (61 m) of the colony or nest. Within this buffer, only ground equipment will be used.

Conclusion. May affect.

Gopherus polyphemus—**Gopher tortoise**

Status. The gopher tortoise was listed as threatened on August 6, 1987, for all areas west of the Mobile and Tombigbee Rivers in Alabama, Mississippi, and Louisiana (52 FR 25380, July 7, 1987).

Description. The gopher tortoise has a large, dark-brown to grayish-black shell that is generally 5.9 to 14.6 inches (15 to 37 cm) in length. A terrestrial turtle, the species has elephantine hind feet and shovel-like forefeet. A gular projection exists below the head of the yellowish, hingeless plastron (Ernst and Barbour, 1972; as cited in 52 FR 25380, July 7, 1987).

Habits. The females reach sexual maturity after 13 to 21 years, and an average of five to eight eggs per clutch is expected when nesting occurs (52 FR 25380, July 7, 1987).

Habitat. Well-drained, sandy soils in transitional areas of forest and grass are the preferred habitat areas for the gopher tortoise (Ernst and Barbour, 1972; as cited in 52 FR 25380, July 7, 1987). The species is usually found where a pine overstory and an open understory with grass and forb ground cover allow ample sunlight to penetrate nesting areas (Landers, 1980; as cited in 52 FR 25380, July 7, 1987). Overall, the gopher tortoise is now found in coastal plain areas of South Carolina, Georgia, Florida, Alabama, Mississippi, and Louisiana (52 FR 25380,

July 7, 1987). The Fish and Wildlife Service's "Counties of Occurrence" list includes Choctow, Mobile, and Washington Counties, Alabama.

Factors in Species Decline. The gopher tortoise's historical range west of the Mobile and Tombigbee Rivers has been significantly reduced by the loss of coastal plain habitat. Urban, crop land, and pasture land developments have destroyed nesting areas and isolated populations. Habitat fragmentation has increased road mortality. The forest management practices of fire suppression and clearcutting have also affected the species. Periodic burning or thinning of forest stands is necessary to maintain an open understory and, consequently, the grasses, forbs, and sunny nesting areas preferred by the species. The suppression of wildfires facilitates forest succession and the closing of the understory. Ultimately, the growth of thick underbrush destroys preferred food plants, inhibits nesting, and forces the gopher tortoise to exposed, marginal areas along the edge of the habitat. Clearcutting similarly forces individuals to the habitat's edge, where chances of roadside mortality or human predation are greatest (52 FR 25380, July 7, 1987).

Recovery Plan. None.

Analysis of Program Impacts. The gopher tortoise's thick carapace and leathery skin should limit any dermal exposure to the boll weevil control program insecticides. The only circumstance that would present a risk to the gopher tortoise would be if the tortoise fed on a large quantity of vegetation immediately after the vegetation had been directly sprayed with insecticide. This scenario is unlikely, but possible, in those areas where cotton is grown immediately adjacent to gopher tortoise foraging habitat. Furthermore, the terrestrial wildlife risk assessment indicates that direct exposure to methyl parathion presents an unacceptable risk to the gopher tortoise. To protect the tortoise from the risk of indirect exposure from the consumption of vegetation sprayed with insecticide, APHIS will avoid the use of methyl parathion in cotton fields adjacent to known gopher tortoise foraging areas in cotton fields in Choctaw, Mobile, and Washington Counties, Alabama. Also, aerial application of malathion and diflubenzuron will be avoided within 200 feet of known foraging areas. Within this buffer, only ground equipment will be used.

Conclusion. May affect.

***Pseudemys alabamensis*—Alabama red-bellied turtle**

Status. The Alabama red-bellied turtle was listed as endangered on July 16, 1987 (52 FR 22943, June 16, 1987).

Description. The Alabama red-bellied turtle has a large, highly arched carapace that is usually 8 to 10 inches (20.3 to 25.4 cm) long. The carapace is brown to olive with yellow, orange, or reddish streaks and light, vertical bars on the pleural scutes. The turtle's skin is olive to

black with yellow-to-light-orange stripes; the plastron is orange red. Other identifying features include a prominent notch at the tip of the upper jaw, bordered on each side by a toothlike cusp (52 FR 22943, June 16, 1987).

Habits. A heliothermic, herbivorous species, the red-bellied turtle often takes refuge in beds of aquatic vegetation, which provides the species with a refuge from predation where the turtle may safely bask and locate food (Dobie, 1985; as cited in 52 FR 22943, June 16, 1987). The species probably nests repeatedly in only one area (52 FR 22943, June 16, 1987).

Habitat. The backwater areas of fresh water bays, usually 3.3 to 6.6 feet deep, with dense growths of submerged and emergent aquatic vegetation, are the preferred habitat of the red-bellied turtle. The lower floodplain of the Mobile River system in Baldwin and Mobile Counties, Alabama, is the current habitat. However, only one known nesting site still exists within this habitat range (52 FR 22943, June 16, 1987).

Factors in Species Decline. The historic range of the red-bellied turtle once extended as far north as Monroe County, Alabama. However, heavy recreational use of the preferred nesting grounds has reduced the distribution and size of the population. During the summer nesting period, campers frequent the nesting beaches, and the lights, people, and noise discourage or prevent the turtles from laying eggs. Offroad vehicles may trample nests and uncover eggs, exposing them to egg breakage, dehydration, or predation (B. Weisberger, personal communication to Fred M. Bagles; as cited in 52 FR 22943, June 16, 1987). The fish crow (*Corvus ossifragus*) preys heavily on red-bellied turtle eggs, seriously limiting the reproductive success in the only nesting area. Human predation is an additional concern; local residents have been known to gather the eggs for food, while collectors and poachers have sold the turtles as pets and food (52 FR 22943, June 16, 1987).

Recovery Plan. None.

Analysis of Program Impacts. The results of the aquatic species risk assessment indicate that malathion, diflubenzuron, and methyl parathion are unlikely to present an unacceptable risk to the species in rivers that could receive insecticide drift or runoff. Also, the Alabama red-bellied turtle is unlikely to be affected by food-source depletion because the species' diet consists primarily of plant material. To eliminate the risk of accidental direct spray, aircraft will avoid overflights of the Mobile River system in Baldwin and Mobile Counties, Alabama, where the red-bellied turtle is known to occur.

Conclusion. May affect.

Sternotherus depressus—**Flattened musk turtle**

Status. The flattened musk turtle was listed as threatened on June 11, 1987 (52 FR 22430, June 11, 1987).

Description. This turtle is aquatic and has a flattened, dark-brown-to-orange carapace (maximum length of 4.7 inches (12 cm)) and a pinkish-yellow plastron. The head is greenish with a dark reticulum that may be spotted along the top of the snout (Mount, 1981; as cited in FWS, 1990). The male turtle attains a body length of 2.4 to 2.6 inches (6 to 6.6 cm), and the female is slightly larger (2.8 to 3.0 inches (7 to 7.6 cm)) (Close, 1982; as cited in FWS, 1990). Other distinguishing characteristics include two barbels on the chin, webbed feet, and the male's long, spine-tipped tail (Ernst and Barbour, 1972; as cited in FWS, 1990).

Habits. This species has a low reproductive rate; one or two clutches per season with an average of three eggs per clutch are delivered each year. The turtle reaches sexual maturity after 4 to 8 years (Close, 1982; as cited in FWS, 1990). Mollusks are its primary food source (Marion et al., 1986; as cited in FWS, 1990).

Habitat. Free-flowing creeks and small rivers are the flattened musk turtle's optimum habitats, and they usually contain vegetated shallows interspersed with deeper pools where numerous crevices, submerged rocks, and boulders provide refuge. Other factors include an abundant supply of mollusks, low-silt load and deposits, low-nutrient content and bacterial count, and moderate temperature (FWS, 1990). The species is currently restricted to Alabama's Black Warrior River upstream from the Bankhead Dam (52 FR 22430, June 11, 1987). The Fish and Wildlife Service's "Counties of Occurrence" list includes Blount, Cullman, Etowah, Marshall, Lawrence, Tuscaloosa, Winston, Jefferson, and Walker Counties, Alabama. However, Jefferson and Walker are not cotton-producing counties.

Factors in Species Decline. The historical range of the flattened musk turtle extended throughout the upper Black Warrior River drainage. The species was isolated upstream by the fall line or the steep edge of the Alabama coastal plain. This natural barrier prevented hybridization with other turtle species, preserving the flattened musk turtle as a genetically unique species. However, water impoundments eliminated the barrier and facilitated the overlap of habitat and possibly the hybridization of the flattened musk turtle with a similar species, *Sternotherus minor peltifer* (Iverson, 1977; as cited in FWS, 1990). The Bankhead Dam, constructed before the wide-scale development of the river system, remains the only effective barrier to hybridization, and populations of the flattened musk turtles above the dam are the only ones known to be genetically pure. The decline of the species above and below the dam also has been facilitated by habitat loss through development, siltation, and pollution. Historically, silt-laden runoff from mining operations, agriculture, industrial or residential development, and forest-harvesting operations affected the molluscan fauna on

which the turtles feed and buried portions of the rocky habitat. Water quality continues to be a concern. Development in the Black Warrior River basin has polluted numerous streams, and some of these streams are now classified for agricultural and industrial use only. Diseases and parasites have been found in past studies of flattened musk turtle populations. A disease characterized by a gram-negative septicemia was found in 1988; nearly one-fourth of all turtles captured at one site were diseased, and one-half of all turtles observed basking were believed to be sick (Dodd et al., 1988; as cited in FWS, 1990). Finally, flattened musk turtle collecting by dealers has seriously damaged some populations (FWS, 1990).

Recovery Plan. The objective of the Flattened Musk Turtle Recovery Plan is to remove the flattened musk turtle from the list of threatened species. Actions to be taken include improving habitat, assessing the nature and magnitude of all threats to this species, reducing the isolation of individual populations, and decreasing the incidence of disease (FWS, 1990).

Analysis of Program Impacts. The results of the aquatic species risk assessment indicate that malathion, difluben-zuron, and methyl parathion are unlikely to present an unacceptable risk to the species in rivers that could receive insecticide drift or runoff. Also, the flattened musk turtle is unlikely to be affected by food-source depletion because the species' diet consists primarily of mollusks, which should not be adversely affected by control program activities (see the species-specific discussions for clams). To eliminate the risk of an accidental direct spray, aircraft will avoid overflights of sections of the Black Warrior River in Alabama where the flattened musk turtle is known to occur.

Conclusion. May affect.

***Drymarchon corais couperi*—Eastern indigo snake**

Status. The eastern indigo snake was listed as threatened on March 3, 1978 (43 FR 4028, January 31, 1978).

Description. This snake attains a length of approximately 8 feet (2.63 m) and has a lustrous black body. Except for red or cream markings on the chin, throat, and sometimes the cheeks, this lustrous black appearance is uninterrupted for the entire span of the snake's body. Other identifying characteristics are the large, smooth scales and the undivided anal plate (FWS, 1982b).

Habits. A generalized predator, the eastern indigo snake will feed on any vertebrate small enough to overpower, including fish, frogs, toads, snakes, lizards, turtles, turtle eggs, small alligators, birds, and small mammals. The snake is not territorial and may cover a wide range, depending on the season. During the winter (December through April), the species inhabits a range of about 19.5 acres (4.8 hectares) and then

increases its living area through the warm spring months to a summer (August through November) range of 91.4 hectares (FWS, 1982b).

Habitat. Although the eastern indigo snake is not a true migrating species, it exhibits a seasonal shift in habitats (Speake et al., 1978; as cited in FWS, 1982b). Dry, sandy ridges are the preferred winter habitat, and the snake often takes refuge in the abandoned nesting burrows of the gopher tortoise (*Gopherus polyphemus*) found in the sandhill environment. The summer habitat includes adjacent, wetter areas. The species may occur in Mobile, Baldwin, Washington, Escambia, and Covington Counties, Alabama. In addition, the Fish and Wildlife Service's "Counties of Occurrence" list includes Bullock and Conecuh Counties, Alabama.

Factors in Species Decline. Loss of habitat through increased urbanization and agricultural development has contributed to the population decline of the eastern indigo snake. Habitat fragmentation has isolated snake populations and increased highway mortality. The decline of the gopher tortoise, also a threatened species, has reduced the area of the snake's potential habitat by decreasing the number of sandy ridge burrows available for winter refuge (FWS, 1982b).

Recovery Plan. The recovery objective is to remove the eastern indigo snake from the Federal endangered and threatened species list. Delisting will occur when numerous populations of the snake are stable or expanding and when habitat areas are adequately protected in the historical range of the species. Also included in the plan are the development of population-monitoring methods, the study of captive breeding and restocking potentials, the study of habitat requirements for juveniles, the reestablishment of the species where feasible, and the improvement of public attitudes and behavior toward the snake (FWS, 1982b).

Analysis of Program Impacts. Although the terrestrial wildlife risk assessment indicates that direct exposure to malathion and methyl parathion presents an unacceptable risk to the eastern indigo snake, the species' size, vertebrate diet, and wide foraging range should eliminate any potential risk from the boll weevil control program. Insecticide exposure through secondary poisoning should not affect the species because of its large size and the high doses that would be required to affect it. Although adverse effects to the indigo snake are unlikely, the risks would be minimized by emphasizing the use of diflubenzuron in cotton fields near the snake's habitat. However, the sole use of diflubenzuron all season is not a feasible option because of the need to follow early diflubenzuron treatments with one of the organophosphate insecticides— malathion or methyl parathion. Aerial applications of the organophosphate insecticides should be avoided within 300 feet (91 m) of known indigo snake habitat. Within this buffer, only ground application equipment will be used.

Conclusion. May affect.

Notropis cahabae—**Cahaba shiner**

Status. The Cahaba shiner was listed as an endangered species on October 12, 1990 (55 FR 42966, October 25, 1990).

Description. *N. cahabae* is a small, delicate-bodied and silvery colored shiner that attains a length of about 2.5 inches (6.4 cm). The body also possesses a peach-colored, narrow stripe over the dark lateral stripe (55 FR 10083, March 19, 1990). The Cahaba shiner differs from a closely related species, the mimic shiner (*N. volucellus*), in several ways—the Cahaba shiner's lateral stripe does not expand before the causal spot, the species lacks a predorsal dark blotch, its dorsal caudal peduncle scales are uniformly dark and pigmented, and its predorsal scales are broadly outlined and diffuse (Mayden and Kuhadjda, 1989; as cited in 55 FR 10083, March 19, 1990).

Habits. The Cahaba shiner spawns from late May through June and apparently has a more limited spawning period than other fish of similar adult size. Prespawning populations of the species have been observed at the tail of a long pool, in a moderate current with a depth of 1.2 to 2.0 feet (36.5 to 61 cm) and just before the head of a main riffle (Ramsey, 1982; as cited in 55 FR 10083, March 19, 1990).

Habitat. The species prefers large shoal areas of the main channel of the Cahaba River, usually in quieter waters less than 1.64 feet (50.3 cm) deep and just below swift riffle areas (Howell et al., 1982; as cited in 55 FR 10083, March 19, 1990). Also, the shiner prefers patches of sandy substrate at the edge of or scattered throughout gravel beds or downstream of larger rocks and boulders. Furthermore, the species occurs in streams with a stable riparian zone and water temperatures ranging from 23 to 62°F (11 to 29°C). Similar to the mimic shiner, the species probably requires a river with sufficient populations of small crustaceans, insect larvae, and algae for food (Gilbert and Burgess, 1980; as cited in 55 FR 10083, March 19, 1990). The Cahaba shiner currently exists in a 60-mile (97-km) section of the Cahaba River, which extends from a point 3 miles (4.8 km) northeast of Heiberger to about 4 miles (6.4 km) above Booth Ford (Pierson et al., 1989a; Howell et al., 1982; as cited in 55 FR 10083, March 19, 1990). The habitat range passes through Perry, Bibb, and Shelby Counties, Alabama (55 FR 10083, March 19, 1990).

Factors in Species Decline. The degradation of water quality in the Cahaba River has been the primary factor in the decline of the Cahaba shiner. For example, residential and industrial sewage effluents, urban runoff, and siltation from construction activities, agriculture, forestry, and coal strip-mining all have contributed to the reduction in water quality. Furthermore, the Cahaba shiner's low numbers and scattered populations, its restricted range, and its limited spawning interval make the species susceptible to any natural or humanmade environmental disturbances (55 FR 10083, March 19, 1990).

Recovery Plan. None.

Analysis of Program Impacts. The results of the aquatic species risk assessment indicate that malathion presents an unacceptable risk to the species in rivers that could receive drift and runoff from treated areas immediately upgradient from shiner habitat. If the Cahaba shiner's diet includes aquatic invertebrates, the species may be indirectly affected by food supply depletion. The possible risk from malathion could be reduced to acceptable levels if malathion is used no closer than 115 feet (35 m) upgradient of known shiner habitat. Best management practices should be strongly encouraged to decrease the runoff from adjacent fields. The use of diflubenzuron or methyl parathion is unlikely to affect the species during program operations. To protect the species from accidental spray, aircraft overflights of the shiner's known habitat will be avoided in the Cahaba River in Perry, Bibb, and Shelby Counties, Alabama.

Conclusion. May affect.

***Speoplatyrhinus poulsoni*—Alabama cavefish**

Status. The Alabama cavefish was originally listed as threatened on October 11, 1977 (42 FR 45528, September 9, 1977). The species was reclassified as endangered on October 28, 1988 (53 FR 37970, September 28, 1988).

Description. The Alabama cavefish is an extremely rare, monotypic species with a standard length range of 1.2 to 2.3 inches (31.2 to 58.3 mm) (Cooper, 1980; as cited in FWS, 1985d). Adapted to life in the dark, cool environment of a cave, the Alabama cavefish has no externally visible eyes or any obvious pigmentation. However, it does appear pinkish white (Cooper and Kuehne, 1974; as cited in FWS, 1985c).

Habits. Few data have been accumulated on the Alabama cavefish, and fewer than 100 individuals are thought to exist. However, the species probably possesses the characteristics generally noted for troglodytic amblyopsids—namely, low reproductive rates with great longevity, long generation time, small numbers of offspring, few reproductive females, and branchial incubation and fry protection. The diet is undetermined, but copepods, isopods, amphipods, and small crayfish are likely food sources (FWS, 1985c).

Habitat. The Alabama cavefish's only known habitat is Key Cave in Lauderdale County, Alabama. This area has been designated as critical habitat (42 FR 45528, September 9, 1988).

Factors in Species Decline. Groundwater degradation is a possible threat to the Alabama cavefish population in Key Cave. A hydrologic study conducted for a proposed landfill indicated that the recharge areas for Key Cave lie within a heavily used agricultural area (Aley, 1986; as cited in 53 FR 37970, September 28, 1988). The Florence

Demonstration Project, a sewage sludge disposal program, is operated on likely recharge areas. Thus, contaminants from agricultural row crops and the sewage program may ultimately enter the Key Cave aquifer and could reduce the cavefish's viability. In addition, any reduction in the size of the gray bat (*Myotis grisescens*) maternity colony in Key Cave will affect the Alabama cavefish. Guano from the bats provides the cave ecosystem with the supply of organic matter necessary to maintain the cave's food chain (53 FR 37970, September 28, 1988).

Recovery Plan. The recovery objective is to remove the species from the Federal list of endangered and threatened species. (Note that the recovery plan has not been updated to reflect the Fish and Wildlife Service's recent reclassification of the Alabama cavefish as an endangered species.) The delisting objective will be considered fulfilled when five distinct and healthy, unthreatened populations exist outside of the Key Cave area. The plan also includes the study of hydrological patterns in the Key Cave area, assessment and monitoring of the aquifer supplying Key Cave, assessment and protection of the cave's energy flow (particularly the gray bat's effect on cave energy dynamics), and a complete biological study of the Key Cave ecosystem (FWS, 1985c).

Analysis of Program Impacts. The GLEAMS model was unable to predict the potential insecticide concentrations in the cavefish's habitat because the species lives in a protected cave that is fed by an undetermined level of groundwater flow. However, the results of the aquatic species risk assessment for other endangered, threatened, and proposed species suggest that malathion may present a risk to the species. The cavefish is unlikely to experience direct toxic effects because the species' only known habitat, Key Cave, should adequately protect it from insecticide exposure. Although all insecticides have the potential to affect aquatic invertebrate populations, which may be the cavefish's food source, the natural protection afforded by the cave also should reduce that risk. Also, groundwater contamination is unlikely because none of the control program insecticides has demonstrated significant leaching potential. Standard operating procedures for the boll weevil program reduce the risk that groundwater may become contaminated. These procedures incorporate adequate safeguards for mixing, loading, and storing insecticides. The procedures also guide program personnel in the proper handling of emergency spills and the disposal of insecticide containers. To protect the Alabama cavefish from the possible risk from the use of malathion, APHIS will avoid the use of malathion around the recharge areas sustaining Key Cave in Lauderdale County, Alabama. In these areas only diflubenzuron or methyl parathion will be used. Also overflights of Key Cave and its known recharge areas will be avoided.

Conclusion. May affect.

***Etheostoma* (=*Nothonotus*) *wapiti*—Boulder darter**

Status. The boulder darter was listed as endangered on October 3, 1988 (53 FR 33998, September 1, 1988).

Description. Like many of the darters, the boulder darter is a very rare, small fish. Its maximum length is about 3 inches (7.6 cm) (Dr. David Etnier, University of Tennessee, personal communication to Richard G. Biggins; as cited in FWS, 1989). Both the male and female boulder darter have olive-gray bodies, although the females are slightly lighter. Both sexes have a gray-black bar below the eye and a similarly colored spot behind the eye (FWS, 1989).

Habits. The boulder darter prefers warm water riverine environments with a moderate to swift current, a large boulder or slab rock substrate, and a water depth of 2 feet (0.6 cm) (O'Bara and Etnier, 1987; as cited in FWS, 1989). Juvenile boulder darters probably occur in habitat areas with smaller substrate size (Charles Saylor, Tennessee Valley Authority, personal communication to Richard G. Biggins; as cited in FWS, 1989). Although little is known about the boulder darter's food habits, the available information on the food habits of other *Nothonotus* spp. indicates that the species may feed primarily on immature aquatic insects (Stile, 1972; as cited in FWS, 1989).

Habitat. A 60-mile segment of the Elk River in Giles and Lincoln Counties, Tennessee, and Limestone County, Alabama, and a 2-mile (3.2-km) section of the Richland and Indian Creeks in Giles County are the only known remaining habitats for the boulder darter (FWS, 1989).

Factors in Species Decline. The traditional habitat boundaries of the boulder darter in the Elk and Tennessee Rivers have been substantially reduced by the construction of river impoundments. Cold water releases from the Tims Ford Reservoir prevent boulder darter repopulation on the upper Elk River. Flooding by other dams and pollution from a manufacturing facility also have contributed to the population's decline. Because of the limited area of the boulder darter's habitat, any reduction in water quality or habitat size could impose additional threats to its survivability (FWS, 1989).

Recovery Plan. The primary goal of the recovery plan is to restore viable populations to significant portions of the historic range. To accomplish this goal, the plan advocates the preservation of current populations and habitat areas, the search for additional populations and habitat areas suitable for reintroduction efforts, and the implementation of a monitoring program to assess population levels and habitat conditions. The species will be considered for reclassification from endangered to threatened status when two distinct, viable populations exist, when studies of the biological and ecological requirements have been completed, and when the data from such studies are incorporated into a successful management strategy. The species will be considered for delisting from Federal protection when three distinct, viable

populations exist, when all studies of the biological and ecological requirements have been completed, and when there are no foreseeable threats to the survival of any of the populations (FWS, 1989).

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, malathion presents an unacceptable risk to the boulder darter in rivers that could receive drift and runoff from treated areas immediately upgradient from darter habitat. If the boulder darter's diet includes aquatic invertebrates, the species may be indirectly affected by food supply depletion. To prevent possible risks from malathion, its use should be limited to 60 feet (18 m) upstream from the boulder darters' habitat. Drift buffers of 200 feet (61 m) for aerial applications and 50 feet (15 m) for ground applications should be instituted for fields abutting rivers containing boulder darter habitat. Best crop management practices should be strongly encouraged to decrease runoff from adjacent fields. The use of diflubenzuron or methyl parathion is unlikely to directly affect the species during program operations. To protect the species from accidental direct spray, aircraft overflights of known current habitat in the Elk River in Limestone County, Alabama, will be avoided.

Conclusion. May affect.

***Etheostoma boschungi*—Slackwater darter**

Status. The slackwater darter was listed as threatened on October 11, 1977 (42 FR 45528, September 9, 1977).

Description. Little growth and development data exist for the slackwater darter, but medium-sized individuals are generally 1.6 to 2.8 inches (40 to 70 mm) long (Williams and Robison, 1980; as cited in FWS, 1984c). The species is best recognized by its three prominent dorsal saddles and a bold, blue-black subocular bar (FWS, 1984c).

Habits. Various species of crustaceans and insects constitute the slackwater darter's food supply (FWS, 1984c).

Habitat. The slackwater darter occupies two distinct habitats, depending on its breeding cycle. The nonbreeding habitat includes small to moderately large streams with slow-moving water. In this habitat, the slackwater darters aggregate over silty gravel, silt, or mud substrates containing a detritus layer of twigs and decayed leaves. During the breeding season, the fish inhabit seepage pools in adjacent fields and woods that are created after spring floods. However, the fish must have access to the open stream waters from the breeding habitat. Critical habitat for the slackwater darter has been established in Lauderdale County, Alabama. The habitat in Lauderdale County includes all permanent or intermittent streams (December to June) that are tributaries to Cypress Creek or its tributaries upstream from the junction of Burcham Creek, including Burcham Creek but excluding Threet Creek (42 FR 45528, September 9, 1977). Outside of the critical

habitat area, populations of the slackwater darter are found in the Flint River in Madison County, Alabama, and in Swan Creek in Limestone County, Alabama (FWS, 1984c). In addition, the Fish and Wildlife Service's "Counties of Occurrence" list includes Morgan County, Alabama.

Factors in Species Decline. Spreading urbanization and the degradation of surface and groundwater sources have destroyed much of the slackwater darter's habitat. The historic and current habitat is surrounded by agricultural and cattle lands. Consequently, chemical and biological wastes from adjacent farms, cattle operations, sewage lines, and septic tanks have contributed to the decline in water quality (FWS, 1984c).

Recovery Plan. The removal of the slackwater darter from the Federal endangered and threatened species list is the primary goal of the Slackwater Darter Recovery Plan. This goal is to be achieved by protecting one or more critical habitat areas in at least three tributaries of the Tennessee River system, protecting species' spawning areas by land purchase or cooperative agreement, and having monitoring programs indicate that there are stable or expanding populations and that the habitat is stable or improving (FWS, 1984c).

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, malathion presents an unacceptable risk to the slackwater darter in rivers that could receive runoff from the cotton fields sprayed over the entire watershed. Also, malathion presents an unacceptable risk to the slackwater darter in rivers that could receive drift and runoff from treated areas immediately upgradient from darter habitat. Any of the three insecticides may cause a temporary reduction in the species' food supply. The possible risk from malathion could be reduced to acceptable levels if no more than 550 acres (3 percent of the total cotton acres in the watershed) of cotton are treated at any one time. Consequently, the use of malathion should be limited over the watershed and limited to 120 feet (37 m) upstream from the slackwater darter's habitat. Drift buffers of 200 feet (61 m) for aerial applications and 50 feet (15 m) for ground applications should be instituted for fields abutting rivers containing slackwater darter habitat. Best crop management practices should be strongly encouraged to decrease runoff from adjacent fields. The use of diflubenzuron or methyl parathion is unlikely to affect the species during program operations. To protect the species from accidental direct spray, aircraft overflights of critical habitat in Lauderdale and Morgan Counties, Alabama, will be avoided.

Conclusion. May affect.

***Percina tanasi*—Snail darter**

Status. The snail darter was originally listed as endangered on October 9, 1975 (40 FR 47506, October 9, 1975). The species was reclassified as threatened on August 6, 1984 (49 FR 27514, July 5, 1984).

Description. The snail darter reaches a maximum length of 3 to 4 inches (7.6 to 10.2 cm) and a mean adult weight of 0.18 ounces (5 g). The upper portion of the fish's side has a brownish background color with traces of green, while the lower portion is lighter with dark blotches. Dark brown saddle marks are present across the back, and the belly is white. The head has various shades of brown with traces of yellow (49 FR 27514, July 5, 1984; FWS, 1982c).

Habits. Small snails are the snail darter's most common food source (Ono et al., 1983). During the spawning season, eggs are deposited on gravel or rocks, and hatching occurs in about 15 to 20 days. Larvae then drift to the main stem of the Tennessee River and spend their first 5 to 7 months there. Juveniles migrate back to the shoal areas of tributaries to spend the rest of their lives, reaching a maximum age of 5 to 6 years (FWS, 1982c).

Habitat. Gravelly shoals are the snail darter's preferred habitat. The species is now found in six tributaries of the Tennessee River and in short sections of the Tennessee River's main stem. This habitat lies in Jackson and Madison Counties, Alabama (49 FR 27514, July 5, 1984). The Fish and Wildlife Service's "Counties of Occurrence" list includes Marshall County, Alabama.

Factors in Species Decline. The historic range of the snail darter is unknown because the species was never surveyed before the wide-scale construction of river impoundments in the Tennessee River drainage. As demonstrated by the Tellico Dam project in the 1970's, however, water impoundments destroy snail darter habitat by flooding gravelly shoal areas. Also, pesticide runoff and stream siltation from adjacent agricultural lands may threaten the species (49 FR 27514, July 5, 1984).

Recovery Plan. The ultimate goal of the Snail Darter Recovery Plan is to complete the delisting of the species from the Federal endangered and threatened species list. The species will be considered recovered when all present and foreseeable threats to its continued survival are eliminated and when one of the following alternatives are met: (1) suitable habitat areas of the Tennessee River are inhabited by independently reproducing populations; (2) additional Tennessee River tributary populations are discovered and existing populations remain viable, and (3) stable or expanding populations exist in five separate streams of the historic range, either through the maintenance of current populations or the expansion of these populations (FWS, 1982c).

Analysis of Program Impacts. Malathion presents an unacceptable risk to the snail darter in rivers that could receive drift and runoff from

treated areas immediately upgradient from darter habitat. Any of the three program insecticides may cause a temporary reduction in the species' food supply. The possible risk from malathion could be reduced to acceptable levels if the use of malathion is limited to 120 feet (37 m) upstream from the snail darter's habitat. Drift buffers of 200 feet (61 m) for aerial applications and 50 feet (15 m) for ground applications should be instituted for fields abutting rivers containing snail darter habitat. Best crop management practices should be strongly encouraged to decrease runoff from adjacent fields. The use of diflubenzuron or methyl parathion is unlikely to directly affect the species during program operations. To protect the species from accidental direct spray, aircraft overflights of critical habitat will be avoided.

Conclusion. May affect.

***Acipenser oxyrhynchus desotoi*—Gulf sturgeon**

Status. The Gulf sturgeon was proposed for listing as a threatened species on May 2, 1990 (55 FR 18357, May 2, 1990).

Description. The Gulf sturgeon is a large, nearly cylindrical subspecies of the Atlantic sturgeon (*Acipenser oxyrhynchus*). It possesses an extended snout, ventral mouth, and chin barbels and the upper lobe the tail is longer than the lower lobe. Adult sturgeons range from 1.8 to 2.4 meters (6 to 8 feet) or more in length, and the females are generally larger than the males. The species' scaleless skin is brown dorsally and pale ventrally and is imbedded with five rows of bony plates (55 FR 18357, May 2, 1990).

Habits. *A. oxyrhynchus desotoi* is a bottom-feeding species that eats primarily invertebrates, including brachiopods, insect larvae, mollusks, worms, and crustaceans. Most adult feeding occurs in the Gulf of Mexico and its estuaries. As an anadromous species, however, reproduction occurs in fresh water and individuals probably breed in the same river system in which they hatched. Spawning occurs in areas of deep water with clean rock, gravel, or sand bottoms (Barkuloo, 1988; as cited in 55 FR 18357, May 2, 1990). The Gulf sturgeon is a slow-maturing, long-lived fish; females require 8 to 12 years to reach sexual maturity, while males need 7 to 10 years (Huff, 1975; as cited in 55 FR 18357, May 2, 1990).

Habitat. The Gulf sturgeon's historical range extended from the Mississippi River to Tampa Bay, Florida. Although the species still occurs sporadically throughout its historic range, it is now essentially restricted to the eastern half of the Gulf of Mexico where the predominantly hard bottoms provide suitable feeding habitat (Barkuloo, 1988; as cited in 55 FR 18357, May 2, 1990). The Suwannee River contains the healthiest remaining population of gulf sturgeon, but within the past 5 years the species has also been identified in Lake Pontchartrain, Louisiana; the Mobile River system in Alabama; and the Pascagoula

and Pearl Rivers in Mississippi. The Fish and Wildlife Service's "Counties of Occurrence" list includes all large rivers in Alabama and Florida leading to the Gulf of Mexico.

Factors in Species Decline. The primary factor in the decline of the Gulf sturgeon has been the impoundment of the major rivers and their tributaries in the Gulf region. Because the sturgeon is apparently unable to pass through dam systems, the species can no longer access spawning areas upstream from river impoundments. The dredging, desnagging, and spoil deposition activities associated with channel improvement and maintenance also may degrade the species' preferred spawning habitat. Poor water quality may be an additional threat to the Gulf sturgeon because heavy pesticide use has occurred in the watersheds for all of the major rivers in the species' historic range, and some have been contaminated with heavy metals and industrial contaminants (55 FR 18357, May 2, 1990).

Recovery Plan. None.

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, malathion presents a risk to the Gulf sturgeon in rivers that could receive drift and runoff from cotton fields immediately upgradient from sturgeon habitat. Drift buffers of 200 feet (61 m) for aerial applications and 50 feet (15 m) for ground applications should be instituted for fields abutting Gulf sturgeon habitat. Because the Gulf sturgeon is an opportunistic feeder with a varied diet, a short-term reduction in aquatic invertebrate populations should not affect the species. Best crop management practices should be strongly encouraged to decrease the runoff from adjacent fields. The use of diflubenzuron or methyl parathion is unlikely to affect the species during program operations. To protect the species from accidental spray, aircraft overflights of the sturgeon's known habitat will be avoided.

Conclusion. May affect.

***Tulotoma magnifica*—Tulotoma snail**

Status. The tulotoma snail was listed as an endangered species on February 8, 1991 (56 FR 797, January 9, 1991).

Description. T. magnifica is a monotypic, live-bearing snail of the family Viviparidae. It is gill-breathing and operculate and possesses a globular shell that is typically ornamented with spiral lines of knob-like structures (56 FR 797, January 9, 1991). Also, the species is distinguished by an oblique aperture with a concave margin (Burch, 1982; as cited in 56 FR 797, January 9, 1991).

Habits. The tulotoma snail prefers cool, well-oxygenated, clean, and free-flowing waters, and occurs in both the mainstem river and the lower portions of large tributaries (Hershler, 1989; as cited in 56 FR 797,

January 9, 1991). Like other members of the Viviparidae, the tulotoma snail is a filter-feeder (56 FR 797, January 9, 1991).

Habitat. *T. magnifica* occurs in riffles and shoals and is strongly associated with boulder/cobble substrates. It has been found at depths over 15 feet (5 m) in strong currents and tightly clings to the undersides of large rocks during daylight hours. Although the species was once abundant in the main channels of the Coosa and Alabama Rivers, it is currently restricted to four localized populations in the lower, unimpounded portions of Coosa River tributaries in Alabama: Kelly Creek in St. Clair and Shelby Counties; Weogufka and Hatchet Creeks in Coosa County; and Ohatchee Creek in Calhoun County. Also, a single population exists in the Coosa River between the Jordan Dam and Wetumpka in Elmore County (56 FR 797, January 9, 1991).

Factors in Species Decline. The decline of the tulotoma snail is attributed primarily to the loss of suitable habitat caused by extensive channel modifications in the Coosa-Alabama River system. Water impoundment projects for hydropower and dredging for navigation have destroyed much of the species' historic range in the mainstems of the Coosa and Alabama Rivers and backwater from the impoundments has affected the lower reaches of tributaries. These projects have also decreased water quality; hydropower discharge has altered the dissolved oxygen content in river water and has elevated water temperature regimes. In addition, siltation and industrial and municipal waste problems in the Coosa drainage have been implicated in the species' decline (56 FR 797, January 9, 1991).

Recovery Plan. None.

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, malathion presents a risk to the tulotoma snail in rivers that could receive drift and runoff concentrations from treated areas immediately upgradient from snail habitat. Drift buffers of 200 feet (61 m) for aerial applications and 50 feet (15 m) for ground applications of malathion should be instituted for fields abutting streams and rivers containing tulotoma snail habitat. Best crop management practices should be strongly encouraged to decrease runoff from adjacent fields. The use of diflubenzuron and methyl parathion is unlikely to affect the species during program operations. To protect the species from accidental direct spray, aircraft over-flights of the species' known habitat will be avoided.

Conclusion. May affect.

***Potamilus inflatus*—Inflated heelsplitter mussel**

Status. The inflated heelsplitter mussel was proposed for listing as a threatened species on October 27, 1989 (54 FR 43835, October 27, 1989), and was listed as threatened on September 28, 1990 (55 FR 39868, September 28, 1990).

Description. *P. inflatus* has an oval, compressed to moderately inflated thin shell that is brown to black. Juveniles' shells may have green rays. Adults attain a maximum shell length of 5.5 inches (140 mm) (Stern, 1976; as cited in 54 FR 43835, October 27, 1989). The valves may gape anteriorly, and there is a prominent posterior wing that may extend anterior to the beaks in juveniles. The umbos are low and the umbonal cavity is very shallow. The nacre is pink to purple. The species is distinguished from *P. ohioensis* (pink papershell), a closely related species, by shell morphology; compared to *P. ohioensis*, the shell and teeth of *P. inflatus* are more delicate, the shell is darker and has a pointed posterior, and *P. inflatus* appears more inflated with a more developed and rounded posterior ridge. Also, the posterior wing of *P. inflatus* is more pronounced and is abruptly rounded over the dorsum (Hartfield, 1988; as cited in 54 FR 43835, October 27, 1989).

Habits. This mussel prefers habitat areas in slow-to-moderate currents with soft, stable substrates (Stern, 1976; as cited in 54 FR 43835, October 27, 1989). The species has been found in sand, mud, silt, and sandy-gravel but not in large gravel or armored gravel (Hartfield, 1988; as cited in 54 FR 43835, October 27, 1989). Usually, the species occurs on the protected side of bars and may be found at depths greater than 20 feet (6 meters). Although the species has been collected from silty areas, viable populations may not be possible in a silt substrate; adult mussels can probably survive limited amounts of silt where juveniles would suffocate (Hartfield, 1988; as cited in 54 FR 43835, October 27, 1989). Also, the mussels found in silty areas may have been established before the deposition of the silt.

Habitat. The inflated heelsplitter once occurred in the Amite and Tangipahoa Rivers, Louisiana; the Pearl River, Mississippi; and the Tombigbee, Black Warrior, Alabama, and Coosa Rivers in Alabama (Hurd, 1974; Stern, 1976; Hartfield, 1988; all as cited in 54 FR 43835, October 27, 1989). Currently, the species is limited to stretches of the Amite River in Louisiana and the Tombigbee and Black Warrior Rivers in Alabama (Stern, 1976; Hartfield, 1988; both as cited in 54 FR 43835, October 27, 1989). The remaining habitat areas occur in the cotton-producing counties of Greene, Hale, Washington, and Clarke, Alabama.

Factors in Species Decline. Habitat modification is the main cause of the decline of the inflated heelsplitter mussel. The species' preferred habitat areas have been reduced by river channelization, impoundments, flood control levees, channel erosion, gravel mining, and dredging operations. Also, industrial and urban pollution have contributed to the decline. Because the known remaining populations are small and isolated, limited genetic variation may reduce the species' ability to adapt to environmental disturbances (54 FR 43835, October 27, 1989).

Recovery Plan. None.

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, none of the control program insecticides

presents a risk to the inflated heelsplitter mussel in rivers that could receive runoff from an entire watershed. Also, none of the insecticides presents an unacceptable risk to the species in rivers that could receive drift and runoff from treated areas immediately upgradient from mussel habitat. Although unlikely, an emergency jettison of pesticide over inflated heelsplitter mussel habitat would present an unacceptable risk to this species. Aircraft overflights of inflated heelsplitter mussel habitat in cotton-producing counties of Greene, Hale, Washington, and Clarke, Alabama, will be avoided.

Conclusion. May affect.

***Pleurobema taitianum*—Judge Tait's mussel**

Status. Judge Tait's mussel was listed as an endangered species on May 7, 1987 (52 FR 11169, April 7, 1987).

Description. Judge Tait's mussel is a bivalve mollusk about 2 inches (50 mm) long, 1.8 inches (45 mm) high, and 1.2 inches (30 mm) wide. The shell is brown to brownish black, obliquely triangular, and inflated. It has narrowly pointed beaks that are directed forward, a very shallow but distinct furrow, pink-tinted nacre, and shallow beak cavities (52 FR 11169, April 7, 1987).

Habits. The species has historically been found in moderate-to-large rivers with a moderate-to-swift current. The preferred habitats are riffle-run or shoal areas with stable substrates ranging from sandy gravel to gravel-cobble (52 FR 11169, April 7, 1987).

Habitat. Only four sites with suitable habitat remain: the bendway of the Tombigbee River, Sumter County, Alabama; the East Fork of the Tombigbee River, Monroe and Itawamba Counties, Mississippi; the Buttahatchie River, Monroe County, Mississippi; and the Sipsey River, Pickens and Greene Counties, Alabama. The Fish and Wildlife Service's "Counties of Occurrence" list includes Greene, Lamar, and Sumter Counties, Alabama.

Factors in Species Decline. This clam population has declined because of habitat alteration. Modifying the Tombigbee River into a series of impoundments to form a barge canal has adversely affected these species by dredging, increasing silt, reducing water flow, and, possibly, disturbing the movements of host fish.

Recovery Plan. None.

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, none of the control program insecticides presents a risk to Judge Tait's mussel in rivers that could receive runoff from an entire watershed area. Also, none of the insecticides presents an unacceptable risk to the species in rivers that could receive drift and runoff from treated areas immediately upgradient from mussel habitat.

Although unlikely, an emergency jettison of pesticide over Judge Tait's mussel habitat would present an unacceptable risk to this species. Aircraft overflights of Judge Tait's mussel habitat in the Tombigbee and Sipsey Rivers of Alabama will be avoided.

Conclusion. May affect.

***Pleurobema marshalli*—Marshall's mussel**

Status. Marshall's mussel was listed as endangered on May 7, 1987 (52 FR 11169, April 7, 1987).

Description. Marshall's mussel is a bivalve mollusk about 2.4 inches (60 mm) long, 2 inches (50 mm) high, and 1.2 inches (30 mm) wide. The shell has a shallow umbonal cavity, a rounded subovate or slightly elliptical outline, nearly terminal beaks, and very low pustules or welts on the postventral surface (52 FR 11169, April 7, 1987).

Habits. The species has historically been found in moderate-to-large rivers with a moderate-to-swift current. The preferred habitats are riffle-run or shoal areas with stable substrates ranging from sandy gravel to gravel-cobble (52 FR 11169, April 7, 1987). The fish hosts of these clams have not been identified.

Habitat. The only remaining viable habitat is a gravel bar in a bendway of the Tombigbee River in Sumter County, Alabama.

Factors in Species Decline. This clam population has declined because of habitat alteration. Modifying the Tombigbee River into a series of impoundments to form a barge canal has adversely affected this species by dredging, increasing silt, reducing water flow, and, possibly, disturbing the movements of host fish. (52 FR 11169, April 7, 1987).

Recovery Plan. None.

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, none of the control program insecticides presents a risk to the Marshall's mussel in rivers that could receive runoff from an entire watershed. Also, none of the insecticides presents an unacceptable risk to the species in rivers that could receive drift and runoff from treated areas immediately upgradient from mussel habitat. Although unlikely, an emergency jettison of pesticide over Marshall's mussel habitat would present an unacceptable risk to this species. Aircraft overflights of Marshall's mussel habitat in the Tombigbee River in Sumter County, Alabama, will be avoided.

Conclusion. May affect.

***Epioblasma (=Dysnomia) penita*—Penitent mussel**

(The FWS recognizes the following name combinations as equivalent to *Epioblasma penita* (Conrad): *Unio penitus* (Conrad), *Margarito (Unio) penitus* (Conrad), *Margaron (Unio) penita* (Conrad), *Truncilla penita* (Conrad), *Dysnomia penita* (Conrad), *Epioblasma penita* (Conrad), and *Plagiola (Plagiola) penita* (Conrad).)

Status. The penitent mussel was listed as endangered on May 7, 1987 (52 FR 11169, April 7, 1987).

Description. The penitent mussel is a bivalve mollusk about 2.2 inches (55 mm) long, 1.6 inches (40 mm) high, and 1.3 inches (34 mm) wide. The shell is yellowish, greenish yellow, or tawny, sometimes with darker dots. The shell is rhomboid with irregular growth lines and a radially straw-colored nacre (52 FR 11169, April 7, 1987). Females have a large, radially grooved swelling projecting behind the shell.

Habits. The preferred habitats are riffle-run or shoal areas with stable substrates ranging from sandy gravel to gravel-cobble (52 FR 11169, April 7, 1987). Specific host fish of this species are unknown.

Habitat. The only remaining viable habitats are in the Buttahatchie River, Lamar County, Alabama; the East Fork of the Tombigbee River; and one place in the bendway of the Tombigbee River in Sumter County, Alabama.

Factors in Species Decline. This clam population has declined because of habitat alteration. Modifying the free-flowing Tombigbee River into a series of impoundments to form a barge canal has adversely affected this species by dredging, increasing silt, reducing water flow, and, possibly, disturbing the movements of host fish.

Recovery Plan. None.

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, none of the control program insecticides presents a risk to the penitent mussel in rivers that could receive runoff from an entire watershed. Also, none of the insecticides presents an unacceptable risk to the species in rivers that could receive drift and runoff from treated areas immediately upgradient from mussel habitat. Although unlikely, an emergency jettison of pesticide over penitent mussel habitat would present an unacceptable risk to this species. Aircraft overflights of penitent mussel habitat in the Buttahatchie River in Lamar County, Alabama, and the East Fork of the Tombigbee River in Sumter County, Alabama, will be avoided.

Conclusion. May affect.

Lampsilis virescens—**Alabama lamp pearly mussel**

Status. The Alabama lamp pearly mussel was listed as endangered on July 14, 1976 (41 FR 24064, June 14, 1976).

Description. The Alabama lamp pearly mussel is a medium-size, thin freshwater mussel, 1.5 inches (37 mm) long. The shell is elliptical, smooth, and shiny, greenish to straw-colored, and faintly rayed.

Habits. The Alabama lamp pearly mussel inhabits sand and gravel substrates in small to medium streams. Life cycle specifics and periods of reproduction are unknown. Host fish species are unknown.

Habitat. The Alabama lamp pearly mussel is restricted to the Paint Rock River and its tributaries, Hurricane Creek, Estill Fork, and Larkin Fork in Jackson County, Alabama.

Factors in Species Decline. The reasons for the decline of this species are not clearly understood, but impoundments, siltation, dredging and channelling, and pollution may be primary causes.

Recovery Plan. The objective of the Alabama Lamp Pearly Mussel Recovery Plan is to maintain and restore viable populations of this species in a significant portion of its historic range and to remove the species from the Federal list of endangered and threatened species. The species shall be considered recovered when the following two criteria are met:

1. A viable population is established on the Paint River and two additional river systems.

2. The species and its habitat are protected from present and foreseeable human-related or natural threats (FWS, 1985d).

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, none of the control program insecticides presents a risk to the Alabama lamp pearly mussel in rivers that could receive runoff from an entire watershed. Also, none of the insecticides presents an unacceptable risk to the species in rivers that could receive drift and runoff from treated areas immediately upgradient from mussel habitat. Although unlikely, an emergency jettison of pesticide over Alabama lamp pearly mussel habitat would present an unacceptable risk to this species. Aircraft overflights of Alabama lamp pearly mussel habitat in the Paint Rock River and its tributaries, Hurricane Creek, Estill Fork, and Larkin Fork in Jackson County, Alabama, will be avoided.

Conclusion. May affect.

Fusconaia cuneolus—**Fine-rayed pigtoe**

Status. The fine-rayed pigtoe was listed as endangered on July 14, 1976 (41 FR 24064, June 14, 1976).

Description. The fine-rayed pigtoe is medium-sized (approximately 3 inches (75 mm) in length) and distinguished by a yellow-green to brown shell with fine green rays and satin-like appearance. The anterior end of the valve is rounded, and the ventral margin is nearly straight.

Habits. The fine-rayed pigtoe is most often encountered in riffle and run areas of free-flowing streams of moderate gradient and firm, cobble, or gravel substrates. The species is intolerant of lentic conditions and rarely occurs in backwater or pool habitats. The species is tachytictic (that is, the glochidia, or larvae, are released shortly after fertilization in the spring and summer). Specific fish hosts are unknown (FWS, 1984d).

Habitat. This species has been found in tributaries of the Tennessee River above Mussel Shoals, Alabama, and the Paint Rock River in Jackson County, Alabama. The Fish and Wildlife Service's "Counties of Occurrence" list includes Jackson County, Alabama.

Factors in Species Decline. The intense industrial and agricultural development of the Tennessee Valley has destroyed this species' habitat by impoundment, siltation, channelization, and pollution.

Recovery Plan. The objective of the Fine-rayed Pigtoe Recovery Plan is to restore this species to a significant portion of its historic range and to remove it from the Federal list of threatened and endangered species. This species shall be considered recovered when the following criteria are met:

1. A population with recent evidence of recruitment exists in the present range of the species.

2. A viable population exists in one additional stream within the historic range of the species.

3. The species and its habitat are protected from present and foreseeable human and natural threats.

4. Coal-related problems in the Powell and Clinch Rivers are noticeably reduced (FWS, 1984d).

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, none of the control program insecticides presents a risk to the fine-rayed pigtoe in rivers that could receive runoff from an entire watershed. Also, none of the insecticides presents an unacceptable risk to the species in rivers that could receive drift and

runoff from treated areas immediately upgradient from mussel habitat. Although unlikely, an emergency jettison of pesticide over fine-rayed pigtoe habitat would present an unacceptable risk to this species. Aircraft overflights of fine-rayed pigtoe habitat in the tributaries of the Tennessee River, including the Paint Rock River in Jackson County, Alabama, will be avoided.

Conclusion. May affect.

***Plethobasus cooperianus*—Orange-footed pearly mussel (=pimple back)**

Status. The orange-footed pearly mussel was listed as endangered on June 14, 1976 (41 FR 24064, June 14, 1976).

Description. The orange-footed pearly mussel is a large freshwater mussel, 3.7 inches (95 mm) long, 1.8 inches (46 mm) wide, and 3.1 inches (78 mm) high. This species has a large heavy shell, which is nearly circular in outline. The posterior surface is covered with tubercles, varying in size, shape, and arrangement. It is yellowish brown to rusty or chestnut brown; nacre color varies from white to pink.

Habits. Cumberlandian freshwater mussels are most often observed in clean, fast-flowing water in silt-free rubble, gravel, or sand substrates. The orange-footed pearly mussel is tachytictic (that is, glochidia, or larvae, are released by the female shortly after fertilization in the spring or summer). Specific hosts are unknown, but possible host fish include the sauger (*Stizostedion canadense*), the host of the related species *P. cyphyus*.

Habitat. Historically, the orange-footed pearly mussel was common in the Ohio River between St. Marys and Marietta, the Wabash River, and the Cumberland River. This species is presently known only from the Tennessee below Pickwick (Hardin County, Tennessee), Guntersville (Marshall County, Alabama), and Fort Loudon Dams (Loudon County, Tennessee); the Cumberland below Cordell Hull Dam (Smith County, Tennessee); and the lower Ohio below Kentucky and Barklay Dams. The Fish and Wildlife Service's "Counties of Occurrence" list includes Marshall County, Alabama.

Factors in Species Decline. The reasons for the decline of this species are not entirely understood, although impoundments, siltation, and pollution may be principal causes.

Recovery Plan. The objective of the Orange-footed Pearly Mussel Recovery Plan is to maintain and restore populations of the species to a significant portion of its historical range. Actions toward this end include preserving habitat on the Tennessee, Cumberland, and Ohio Rivers and conducting studies to determine the essential habitat, life history, and population biology of the species. The species will be considered recovered under the following conditions:

1. A viable population exists in the Tennessee, Cumberland, and Ohio Rivers.

2. Viable populations exist in two other rivers, through discovery or establishment.

3. The species and its habitat are protected.

4. Siltation problems are noticeably reduced (FWS, 1984e).

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, none of the control program insecticides presents a risk to the orange-footed pearly mussel in rivers that could receive runoff from an entire watershed. Also, none of the insecticides presents an unacceptable risk to the species in rivers that could receive drift and runoff from treated areas immediately upgradient from mussel habitat. Although unlikely, an emergency jettison of pesticide over orange-footed pearly mussel habitat would present an unacceptable risk to this species. Aircraft overflights of orange-footed pearly mussel habitat in Marshall County, Alabama, will be avoided.

Conclusion. May affect.

***Toxolasma (=Carunculina) cylindrellus*—Pale lilliput pearly mussel**

(The FWS recognizes the following name combination as being equivalent to *Toxolasma cylindrellus*: *Carunculina cylindrella*.)

Status. The pale lilliput pearly mussel was listed as endangered on June 14, 1976 (41 FR 24064, June 14, 1976).

Description. The pale lilliput pearly mussel is a bivalve mollusk 1.7 inches (44 mm) long, 1 inch (25 mm) high, and 0.6 inches (16 mm) wide. The shell is cloth-like with yellowish-green coloration and no rays. The valves are solid, elongate, and subinflated with a full beak and no beak sculpturing (FWS, 1984f).

Habits. The species has historically been found in small rivers and streams in shallow, fast-flowing water with clean and stable substrates (FWS, 1984f). This species is bradytictic (that is, glochidia, or larvae, are retained over the winter in the female's gills and released the following spring). The fish hosts are unknown, although experimental studies have successfully transformed juveniles from infected sunfish.

Habitat. The pale lilliput pearly mussel is now known only in the Paint Rock River and its headwater tributary streams, including Hurricane Creek and Estill Fork in northern Alabama and southern Tennessee. The Fish and Wildlife Service's "Counties of Occurrence" list includes Jackson County, Alabama.

Factors in Species Decline. There is little information to indicate whether the population of these clams has declined because of habitat alteration. However, the Cumberlandian faunal group as a whole has suffered from impoundment, siltation, and pollution of the Tennessee and Cumberland Rivers. The completion of the Normandy Dam on the Duck River in 1976 and the Wood's (1952) and Tim's Ford Dams (1970) on the Elk River may have contributed to the decline in population.

Recovery Plan. The objective of the Pale Lilliput Pearly Mussel Recovery Plan is to restore this species to a significant portion of its historical range and to remove the species from the Federal list of threatened and endangered species. This species shall be considered recovered when the following criteria are met:

1. A viable population exists in the Paint Rock River, Estill Fork, and Hurricane Creek.

2. Viable populations exist in two additional rivers.

3. The species and its habitat are protected from present and foreseeable human-related and natural threats.

4. Substrate quality in the Paint Rock River watershed is noticeably improved with regard to siltation (FWS, 1984f).

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, none of the control program insecticides presents a risk to the pale lilliput pearly mussel in rivers that could receive runoff from an entire watershed. Also, none of the insecticides presents an unacceptable risk to the species in rivers that could receive drift and runoff from treated areas immediately upgradient from mussel habitat. Although unlikely, an emergency jettison of pesticide over pale lilliput pearly mussel habitat would present an unacceptable risk to this species. Aircraft overflights of pale lilliput pearly mussel habitat in the Paint Rock River and its tributaries, Hurricane Creek and Estill Fork, in northern Alabama, will be avoided.

Conclusion. May affect.

***Lampsilis orbiculata*—Pink mucket pearly mussel**

Status. The pink mucket pearly mussel was listed as endangered on June 14, 1976 (41 FR 24064, June 14, 1976).

Description. The pink mucket pearly mussel is a bivalve mollusk 4.1 inches (105 mm) long, 3.2 inches (82 mm) high, and 2.4 inches (61 mm) wide. The outer shell covering can be glossy in younger individuals and dull in older ones. Their colors are yellowish or greenish brown, with wide, greenish rays present in young individuals. Valves are inflated, thick, heavy, unsculptured, and gaped at the anterior-ventral base (FWS, 1985e).

Habits. The species is found in medium to large rivers in habitats ranging from silt to boulders, rubble, gravel, and sand substrates. The species is most often associated with larger rivers and moderate- to fast-flowing water. The pink mucket pearly mussel is bradytictic (that is, glochidia, or larvae, are retained over the winter in the female's gills and released the following spring). Specific host fish species are unknown.

Habitat. The greatest concentration of this species is reported in the Tennessee River (Marshall, Colbert, and Lauderdale Counties in Alabama, and Hardin, Loudon, Rhea, and Meigs Counties in Tennessee) and the Cumberland River (Smith County, Tennessee) in Tennessee; the Osage River (Osage County, Missouri); the Meremec River (Jefferson County, Missouri) in Missouri; and the Spring (Fulton County, Arkansas), Black (Butler County, Missouri), and Little Black (Ripley County, Missouri, and Clay County, Arkansas) Rivers in Arkansas and Missouri. Other specimens have been reported in the Paint Rock River in Alabama. Sanctuaries have been established in portions of the Tennessee, Cumberland, and Clinch Rivers. The Fish and Wildlife Service's "Counties of Occurrence" list includes Colbert, Jackson, Marshall, and Morgan Counties in Alabama.

Factors in Species Decline. The pink mucket pearly mussel appears to have adapted to the impounded Tennessee and Cumberland Rivers. Unlike other Cumberland fauna, the river-lake conditions in the upper reaches of these impoundments may be suitable for survival and propagation of this species. As with other Cumberland fauna, impoundments, siltation, and pollution of the river habitats may have contributed to the decline of the species.

Recovery Plan. The objective of the Pink Mucket Pearly Mussel Recovery Plan is to restore this species to a significant portion of its historical range and to remove it from the Federal list of endangered and threatened species. This species shall be considered recovered when the following criteria are met:

1. Two additional populations are established in rivers other than the Tennessee, Cumberland, and Meremec.

2. Additional mussel sanctuaries are established in river systems known to contain the species.

3. An education program is established for the public.

4. The species and habitat are protected from present and foreseeable human-related and natural threats (FWS, 1985e).

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, none of the control program insecticides presents a risk to the pink mucket pearly mussel in rivers that could receive runoff from an entire watershed. Also, none of the insecticides

presents an unacceptable risk to the species in rivers that could receive drift and runoff from treated areas immediately upgradient from mussel habitat. Although unlikely, an emergency jettison of pesticide over pink mucket pearly mussel habitat would present an unacceptable risk to this species. Aircraft overflights of pink mucket pearly mussel habitat in the Tennessee River and the Paint Rock River in Alabama will be avoided.

Conclusion. May affect.

***Pleurobema plenum*—Rough pigtoe**

Status. The rough pigtoe was listed as endangered on July 14, 1976 (41 FR 24064, June 14, 1976).

Description. The rough pigtoe is a medium-size, 2.6-inch (65-mm) long freshwater mussel. Its valves are heavy and solid. Its yellow- to red-brown surface is cloth-like and marked with irregular, concentric growth rings. Nacre color varies from white to pink, red, or orange (FWS, 1984g).

Habits. Cumberlandian freshwater mussels are most often observed in clean, fast-flowing water in silt-free rubble, gravel, or sand substrates. The rough pigtoe is found in sand or gravel substrates of medium to large rivers. The rough pigtoe is tachytictic (that is, glochidia, or larvae, are released by the female shortly after fertilization in mid- to late summer). Specific fish hosts are unknown.

Habitat. This species was formerly found in the Ohio, Cumberland, and Tennessee Rivers and southwest to Arkansas and Kansas. Now the rough pigtoe is found in the Tennessee River downstream from the Guntersville Dam in Marshall County, Alabama, the Wilson Dam in Colbert and Lauderdale Counties, Alabama, and the Pickwick Dam in Hardin County, Tennessee; the Cumberland River downstream of the Cordell Hull Dam in Smith County, Tennessee; the Clinch River between Kyles Ford and Sneedville in Hancock County, Tennessee; the Green River at Lock and Dam #5; and the Barren River at Lock and Dam #1 in Kentucky.

Factors in Species Decline. The reasons for the decline of this species are not entirely understood; impoundments, siltation, and pollution may be principal causes.

Recovery Plan. The objective of the Rough Pigtoe Recovery Plan is to maintain and restore populations of this species to a significant portion of its historical range. Actions toward this end include preserving current populations and habitats, soliciting public support in protecting this species, and determining the feasibility of returning this species to its historic range. The rough pigtoe can be considered recovered under the following conditions:

1. A viable population exists in the Tennessee, Clinch, Cumberland, and Green Rivers.

2. Viable populations exist in two additional rivers.

3. The species is protected from present and foresee-able threats.

4. There have been noticeable reductions in siltation problems and improvements in substrate quality (FWS, 1984g).

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, none of the control program insecticides presents a risk to the rough pigtoe in rivers that could receive runoff from an entire watershed. Also, none of the insecticides presents an unacceptable risk to the species in rivers that could receive drift and runoff from treated areas immediately upgradient from mussel habitat. Although unlikely, an emergency jettison of pesticide over rough pigtoe habitat would present an unacceptable risk to this species. Aircraft overflights of rough pigtoe habitat in the Tennessee River in Alabama will be avoided.

Conclusion. May affect.

Fusconaia edgariana—**Shiny pigtoe**

Status. The shiny pigtoe was listed as endangered on July 14, 1976 (41 FR 24064, June 14, 1976).

Description. The shiny pigtoe is in the family Unionidae. No other description is available.

Habits. Cumberlandian freshwater mussels are most often observed in clean, fast-flowing water in silt-free rubble, gravel, or sand substrates. The shiny pigtoe, like other *Fusconaia* species, is a riffle species, intolerant of lentic conditions. Specific fish hosts are unknown.

Habitat. This species has recently been found in the North Fork Holston River in Smyth County, Virginia; the Clinch and Powell Rivers in Lee and Scott Counties, Virginia, and Clairborn and Hancock Counties, Tennessee; and the Paint Rock River in Jackson County, Alabama.

Factors in Species Decline. The reasons for this species' decline are not fully understood; impoundments, siltation, and pollution may be major causes.

Recovery Plan. None.

Analysis of Program Impacts. According to results of the aquatic species risk assessment, none of the control program insecticides presents a risk to the shiny pigtoe in rivers that could receive runoff

from an entire watershed. Also, none of the insecticides presents an unacceptable risk to the species in rivers that could receive drift and runoff from treated areas immediately upgradient from mussel habitat. Although unlikely, an emergency jettison of pesticide over shiny pigtoe habitat would present an unacceptable risk to this species. Aircraft overflights of shiny pigtoe habitat in the Paint Rock River in Jackson County, Alabama, will be avoided.

Conclusion. May affect.

***Quadrula stapes*—Stirrup shell**
(The USFS recognizes the following name combinations as equivalent to *Quadrula stapes* (Lea): *Unio stapes* (Lea), *Margarita (Unio) stapes* (Lea), *Margaron (Unio) stapes* (Lea), *Orthonymus stapes* (Lea).)

Status. The stirrup shell was listed as endangered on May 7, 1987 (52 FR 11169, April 7, 1987).

Description. The stirrup shell is a bivalve mollusk about 2.2 inches (55 mm) long and 1.2 inches (30 mm) wide. The shell is yellowish green; the green zigzag markings of young individuals become brown with age. It is irregularly quadrate, with a sharp posterior ridge, truncated posterior, tubercles, and a silvery-white nacre that is thinner and iridescent behind (52 FR 11169, April 7, 1987).

Habits. This species has historically been found in moderate to large rivers with moderate-to-swift current. The preferred habitats are riffle-run or shoal areas with stable substrates ranging from sandy gravel to gravel-cobble (52 FR 11169, April 7, 1987). Specific host fish of this species are unknown.

Habitat. The present known distribution of this clam is limited to a reach of the Tombigbee River from near Epes, Alabama, upstream to just above the confluence of Tibbee Creek in Sumter County, Alabama. A specimen has also been collected in the lower Sipsey River, Pickens and Greene Counties, Alabama (52 FR 11169, April 7, 1987). The Fish and Wildlife Service's "Counties of Occurrence" list includes Greene and Sumter Counties, Alabama.

Factors in Species Decline. The population of these clams has declined because of habitat alteration. The modification of the free-flowing habitat of the Tombigbee River into a series of impoundments to form a barge canal has adversely affected this species through dredging, increased siltation, water flow reduction, and possible disturbance of host fish movements.

Recovery Plan. None.

Analysis of Program Impacts. According to the results of the aquatic species risk assessment, none of the control program insecticides presents a risk to the stirrup shell in rivers that could receive runoff

from an entire watershed. Also, none of the insecticides presents an unacceptable risk to the species in rivers that could receive drift and runoff from treated areas immediately upgradient from mussel habitat. Although unlikely, an emergency jettison of pesticide over stirrup shell habitat would present an unacceptable risk to this species. Aircraft overflights of stirrup shell habitat in the Tombigbee River in Sumter County, Alabama, and the Sipsey River in Greene County, Alabama, will be avoided.

Conclusion. May affect.

***Palaemonias alabamae*—Alabama cave shrimp**

Status. The Alabama cave shrimp was listed as endangered on October 7, 1988 (53 FR 34698, September 7, 1988).

Description. This species is colorless and transparent, like other albinistic cave shrimp. It is 0.8 inches (20 mm) long. The other species in this genera, the Kentucky cave shrimp (*Palaemonias ganteri*), is also endangered.

Habits. This species is a troglobite (lives only in caves). Its diet and reproductive behavior are unknown.

Habitat. This species is known only in Shelta and Bobcat Caves, Madison County, Alabama, and may have been extirpated from Shelta Cave. Other species found in this habitat are southern cavefish (*Typhlichthys subterraneous*), cave salamander (*Gyrinophilus palleucus*), and the cave crayfish (*Avticambarus jonesi*). Shelta Cave is owned by the National Speleological Society and is gated to prevent unauthorized visitors; Bobcat Cave is owned by Redstone Arsenal, under the control of the U.S. Army. The Fish and Wildlife Service's "Counties of Occurrence" list includes Madison County, Alabama.

Factors in Species Decline. The biggest threat to the Alabama cave shrimp may be groundwater contamination, possibly by DDT. The shrimp's survival is also affected by its apparently low reproductive capabilities, confined habitat, and inability to elude captors (53 FR 34698, September 7, 1988).

Recovery Plan. None.

Analysis of Program Impacts. The GLEAMS model was unable to predict the potential insecticide concentrations for the three control program chemicals in the Alabama cave shrimp's habitat because it lives in a protected cave that is fed by an undetermined level of groundwater flow. However, the results of the aquatic species risk assessment for other endangered and threatened species suggest that malathion may present a risk to the species. The Alabama cave shrimp is unlikely to experience direct toxic effects because the species' cave habitat should adequately protect it from insecticide exposure.

Although all insecticides have the potential to affect aquatic invertebrate populations, which may be the Alabama cave shrimp's food source, the natural protection afforded by caves should reduce that risk. Also, groundwater contamination is unlikely because none of the control program insecticides has demonstrated significant leaching potential. To eliminate any possible risks from groundwater contamination, standard operating procedures for the boll weevil program incorporate adequate safeguards for mixing, loading, and storing insecticides. The procedures also guide program personnel in the proper handling of emergency spills and disposal of insecticide containers. The use of these procedures will ensure that there is no effect on the Alabama cave shrimp or its habitat. Diflubenzuron and methyl parathion are unlikely to affect the species during program activities. To eliminate the risk of an accidental direct spray, aircraft overflights of Shelta and Bobcat Caves and their recharge areas in Madison County, Alabama, will be avoided.

Conclusion. May affect.

Clematis socialis—**Alabama leather flower**

Status. The Alabama leather flower was listed as endangered on October 27, 1986 (51 FR 34422, September 26, 1986).

Description. This species is a member of the Ranunculaceae family. The plants are 8 to 12 inches (0.2 to 0.3 m) high, and the upper leaves are three to five foliate. Flowers are solitary, blue violet, and urn or bell shaped. Fruits are aggregates of achenes (51 FR 34422, September 26, 1986).

Habits. The Alabama leather flower has a rhizomatous habit and forms dense clones. The flowers bloom from April to May. Very little is known about the pollination of the Alabama leather flower.

Habitat. This species is found in two sites in northwestern Alabama: St. Clair and Cherokee Counties. It is found in silty-clay soil with grass-sedge vegetation along highway rights-of-way. No critical habitat has been designated. St. Clair and Cherokee Counties are the only two counties included in the Fish and Wildlife Service's "Counties of Occurrence" list.

Factors in Species Decline. The decline in population of the Alabama leather flower has been primarily because of mechanical disturbances, such as maintenance of highway rights-of-way and residential development. Because of its horticultural potential, the species may have been affected by overcollection.

Recovery Plan. None.

Analysis of Program Impacts. The Alabama leather flower may be adversely affected by a short-term reduction in insect pollinators. To

protect the species from a depletion of essential insect pollinators, the control program insecticides should not be applied within 300 feet (91.4 m) of known Alabama leather flower habitat during pollination time.

Conclusion. May affect.

***Ptilimnium nodosum*—Harperella (Piedmont Bishop's weed)**

Status. Harperella was listed as endangered on October 28, 1988 (53 FR 37982, October 28, 1988).

Description. Harperella is an annual member of the parsley family (*Apiaceae*). The plants are 0.7 to 3.25 feet (0.2 to 1 m) tall. The leaves are hollow, quill-like structures, and the small white flowers occur in heads.

Habits. Harperella flowers from May until frost. The riverine form of the species is tolerant of periodic, moderate flooding. This adaptation allows Harperella to survive under changing water levels that few plants can tolerate. Very little is known about pollinators.

Habitat. The species typically occurs in two habitat types: rocky or gravelly shoals and on the margins of swift-flowing streams, and the edges of intermittent pineland ponds or wet savanna meadows. Stream populations are found in DeKalb County, Alabama. The Fish and Wildlife Service's "Counties of Occurrence" list also includes Cherokee County, Alabama.

Factors in Species Decline. Because of very specific habitat requirements, the species is highly affected by minor perturbations. Changes in water flow, increases in siltation, and changes in nutrient concentration in streams have all been linked to the species decline.

Recovery Plan. None.

Analysis of Program Impacts. Because harperella is highly susceptible to increased siltation in riverine habitats, the species may be adversely affected by cultural control methods that increase erosion. The species also may be affected by a short-term reduction in insect pollinators. To protect the species from a depletion of essential insect pollinators, the control program insecticides should not be applied within 300 feet (91.4 m) of known harperella habitat during pollination time.

Conclusion. May affect.

***Marshallia mohrii*—Mohr's Barbara's buttons**

Status. Mohr's Barbara's buttons were declared threatened on October 7, 1988 (53 FR 34701, September 7, 1988).

Description. Mohr's Barbara's buttons is a member of the sunflower family and an erect perennial herb 1 to 2.3 feet (30 to 70 cm) tall. The leaves are alternate, lanceolate-ovate in shape, firm-textured, and 1.2 to 8 inches (3 to 20 cm) long.

Habits. The flowers of Mohr's Barbara's buttons occur in multi-headed inflorescences and are pale pink to lavender in color. Flowering occurs from mid-May through June. Very little is known about the pollinators of Mohr's Barbara's buttons.

Habitat. This species is found in moist, prairie-like openings in woodlands and along shale-bedded streams. It prefers sandy clay soils that are alkaline, high in organic matter, and seasonally wet. Associated species include grasses (*Andropogon, Panicum*), sedges (*Rhynchospora, Carex*), *Siliphium confertifolium, Ruellia pinetorum, Allium cerenuum, Physostegia, and Asclepias englemanniana*. The forest type is mixed hardwoods, primarily Shumard oak, willow oak, and pine. Mohr's Barbara's buttons has been found only in Floyd County, Georgia, and in Bibb, Etowah, and Cherokee Counties in Alabama.

Factors in Species Decline. The decline of Mohr's Barbara's buttons is believed to be the result of habitat destruction caused by highway improvements and conversion to agricultural lands. The plant is also threatened by collection and vandalism because of its high visibility when in bloom.

Recovery Plan. None.

Analysis of Program Impacts. Mohr's Barbara's buttons may be adversely affected by a short-term reduction in insect pollinators. To protect the species from a depletion of essential insect pollinators, the control program insecticides should not be applied within 300 feet (91.4 m) of known Mohr's Barbara's buttons habitat during pollination time.

Conclusion. May affect.

Sagittaria secundifolia—Kral's water-plantain

Status. Kral's water-plantain was listed as a threatened species on May 14, 1990 (55 FR 13911, April 13, 1990).

Description. Kral's water-plantain is a submersed or emersed aquatic perennial that is distinguished by a stout, elongated rhizome approximately 4 inches (10 cm) in length, hairy filaments, linear leaves, and spreading or reflexed sepals. The species displays two types of leaves depending on the velocity and depth of the water it inhabits. In swift shallows, the leaves are linear, rigid, and sickle-shaped, 2 to 3 inches (5 to 8 cm) long, and 0.007 to 0.02 inches (2 to 5 mm) wide. In quiet, deep waters the leaves are more quill-like, longer (4 to 12 inches (10 to 30 cm)), linear in shape, and tapered. Separate male and female

flowers are produced on a stalk 4 to 19.5 inches (10 to 50 cm) long. The petals are inconspicuous in the female flowers; however, in the male flowers they are white and 0.4 to 0.6 inches (1 to 1.5 cm) long. The fruit consists of a cluster of achenes approximately 0.01 inches (2 mm) in length (Kral, 1982, 1983; as cited in 55 FR 13911, April 13, 1990).

Habits. Although infrequent, Kral's water-plantain may flower from May through July and intermittently into autumn (Kral, 1982, 1983; as cited in 55 FR 13911, April 13, 1990). However, flowering has been observed in only 1 percent of the plants known to exist. These flowering plants were in direct sunlight in water shallow enough for emergent leaves. The species is clonal, and reproduction is primarily asexual, which suggests that the species may possess low genetic variability (55 FR 13911, April 13, 1990).

Habitat. Kral's water-plantain typically occurs on narrow stream bottoms bounded by steep slopes, in frequently exposed shoals, or rooted among loose boulders in quiet pools up to 3.3 feet (1 m) in depth. Plants are locally distributed where suitable habitat exists and grow in pure stands or in association with other submergent plants. It is currently known to occur in three areas in the upper free-flowing reaches of the Little River drainage system in northeast Alabama. These habitat areas are located in Cherokee and DeKalb Counties, Alabama (Whetstone, 1988; Whetstone et al., 1988; both as cited in 55 FR 13911, April 13, 1990).

Factors in Species Decline. The critical factor in the decline of Kral's water-plantain has been the elimination or adverse modification of the species' preferred habitat. For example, the clearing of adjacent river banks for silviculture, residential-recreational growth, surface mining, and agricultural development all have destroyed habitat. Furthermore, these activities have contributed to water-quality degradation, an increase in stream turbidity, and siltation (Kral, 1982, 1983; as cited in 55 FR 13911, April 13, 1990). Additionally, eutrophication and water impoundments have affected the viability of this plant (55 FR 13911, April 13, 1990).

Recovery Plan. None.

Analysis of Program Impacts. Because Kral's water-plantain is clonal and reproduces primarily by asexual reproduction, the use of insecticides in the control program should not affect the species. However, because the species is susceptible to increased siltation in its riverine habitat, the species may be affected by cultural control methods that increase erosion, such as certain stalk destruction methods.

Conclusion. May affect.

Trillium reliquum—Relict trillium

Status. The relict trillium was listed as endangered on May 4, 1988 (53 FR 10884, April 4, 1988).

Description. *Trillium reliquum* is an herbaceous perennial of the lily family. It has sessile flowers on S-curved stems. Flowers are greenish to brownish purple or occasionally pure yellow. Fruit is an oval berry-like capsule.

Habits. Flowers appear in early spring, and the plant dies back to the rhizome after the fruit matures. Very little is known about the pollination of the relict trillium.

Habitat. The relict trillium prefers moist hardwood forests in soils with high organic content. The species also occurs on less than optimum sites, such as power and sewer line rights-of-way. There have been populations in Henry and Lee Counties, Alabama.

Factors in Species Decline. These populations have declined because of loss or alteration of habitat resulting from residential development and conversion of habitat to pine monoculture, pasture, and row crop agriculture.

Recovery Plan. None.

Analysis of Program Impacts. The relict trillium may be adversely affected by a short-term reduction in insect pollinators. To protect the species from a depletion of essential insect pollinators, the control program insecticides should not be applied within 300 feet of known relict trillium habitat during pollination time.

Conclusion. May affect.

Appendix I

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